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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, MAY 3, 1894.

THE MODERN INCANDESCENT ELECTRIC LAMP.

The Incandescent Lamp and its Manufacture. By Gilbert S. Ram. (London: *The Electrician* Printing and Publishing Company, Limited.)

NOW the Swan-Edison monopoly is a thing of the past, the manufacture of incandescent lamps is assuming considerable proportions; consumers are already deluged with applications for orders by continental firms, and it is to be hoped that we shall not long be obliged to send abroad for what can so easily be made in our own country. The information in this book is of a unique and valuable nature, and the author seems to have a thoroughly practical acquaintance with the subject, and goes into minute details when dealing with all the different branches of the manufacture. Indeed "trade secretism" seems to have been abolished in these pages, and the wealth of technical information here met with will go far towards the production of a more efficient lamp than those at present in use.

Chapter i. treats of the filament, and after briefly touching on the early efforts to produce lamps with incandescent platinum, and the possibilities of making use of some of the metallic oxides, the author passes to the consideration of carbon filaments now used. It is here noted that "great improvements may yet be looked for in the carbon itself." This is a matter of supreme importance, for the incandescent lamp is as yet in such an early stage of evolution as to make it more than probable that the widening of the sphere of manufacture will soon bring about an advance upon its present excellence; and although, as the author points out, the volatilisation of carbon in *vacuo* will prevent us from attaining to the brightness of the crater of an arc lamp, still there is considerable room for improvement. The "electrical volatilisation" or dissociation of particles of carbon from the filament is noted, and the conclusion is drawn that "the best carbon is one which at the highest possible temperature disintegrates at the slowest rate."

The value of a lamp from the consumer's point of view

must now be modified, since, by the lowering of the price to 1s., the filament can be run at a much higher temperature; for although the life will be thus reduced, this will be more than compensated by the smaller quantity of current used.

The materials at present used for the production of carbon filaments—silk, hair, wood fibre, cellulose—are described, and then chapter ii. begins with the practical preparation of filaments. Swan's process for the parchmentsing of cotton thread is taken first, and a good working sketch is given of an apparatus for producing the thread, together with full instructions for the manipulation and drying. Details are also given of the jewelled draw-plates used for bringing down the dried thread to a uniform diameter. This process is the one to which the author devotes most attention. Other processes, such as those in which zinc chloride, furfural, cuprammonia, pyroxyline and bamboo are used, are mentioned with more brevity.

Carbonisation is very fully treated of, and excellent drawings are given of frames and blocks for holding the filaments during heating. The furnace is then considered, and a drawing is given of a convenient form of carbonising furnace, the chapter closing with instructions for removing the fragile carbons from their frames.

Chapter iv. treats of mounting the filaments on their leading-in wires, and after describing the early form of crayon holder used by Swan, the carbon tube of Lane Fox, and the bolt and nut of Maxim, he passes on to the perfection of all joints—that of deposited carbon. Drawings are shown of machines for making this joint, both in the "socket" and "butt" form, and minute instructions are given for depositing the carbon on the junctions, particularly from a liquid hydrocarbon. That recommended is a mixture of four parts kerosine to one part turpentine.

The next chapter goes thoroughly into the subject of "flashing." Touching briefly on the early days when carbon was deposited on the filament to remedy defects in their uniformity and remove bright spots, the author gives as the reason why it is still necessary to use the process "that the carbon deposited by the flashing process under certain conditions is much more durable than any that can be produced by any other methods." The

various means that have been proposed and used for producing the deposit are then shown, and drawings are given for an apparatus for "coal gas flashing" at atmospheric pressure. It is, however, recommended that the pressure should be reduced, as otherwise there is danger of getting a soft deposit. A detailed description is next given with drawings of an apparatus for flashing in "pentane" vapour at reduced pressure. Different methods for flashing filaments to a uniform resistance or candle-power are described, and it is noted that the specific resistance of hard white carbon deposited from pentane is one-tenth that of carbon deposited from amyloid. Several pages are given to a consideration of the best thickness for the deposited carbon, and a curve diagram is given, showing the effect of reduction of resistance due to flashing for filaments of various diameters.

In chapter vi. are given useful formulæ for finding the sizes for filaments for lamps of various candle-powers, with either round, flat, square, or tubular filaments, based on the data obtained from amyloid carbon with unpolished surface. In connection with tubular filaments, the fallacy of supposing them to be more economical than the solid form "because all the power is used in heating the surface," is explained.

Chapter vii. gives the sizes necessary for the production of lamps of various candle-powers, using flashed filaments. This is far more difficult than in the case of unflashed carbons, and instead of giving the cumbersome formula necessary, a number of different cases are worked out separately, and the results given in a series of curves from which the sizes for any other candle-power can be quickly obtained. At the conclusion of this chapter, the author alludes to a very amusing instance of what he calls the "happy-go-lucky" method of working that he encountered in a factory some few years ago. The name of the works in question is not divulged, and as he speaks of it being in a country where "very badly matched lamps" could be sold as of the same voltage, we hope England is not responsible. We thoroughly endorse his opinion that the most carefully made lamps, even though the price may be higher, will prove the cheapest in the end. This is a point in the manufacture of lamps which deserves more attention than is usually given to it, and a thorough grasp of the contents of these chapters will be of great value to anyone intending to take up the subject seriously. The aim of the manufacturer should be to turn out the most perfect lamp possible, and one in which the limit of endurance has been attained. Practice will then reduce the cost of production.

Chapter viii. contains a brief description of various gauges used for measuring the diameters of filaments. Although it is not mentioned, we should think the beautiful little instrument used for measuring the thickness of microscopic cover glasses would answer the purpose admirably.

A chapter is devoted to glass-making, including a list of ingredients necessary for the manufacture of lead glass, the kind of pots for melting the "metal" in, and a short description of the method of blowing "pot-bulbs" in a mould. Glass-blowing is fully gone into, and, after describing the playful way in which the old-fashioned orthodox glass-blowers "spoiled" the electricians in the early days of lamp-making, we come to the invention of

the glass-blowing machine, and the final springing into existence of a race of girl glass-blowers free from the vices of drink, strikes, and "Saint Monday."

We then have a few pages with illustrations showing the various forms of blowpipes, ending with practical instructions for making lamp bulbs from glass cylinders. This is given somewhat briefly, doubtless owing to the fact that it is pretty evident that the day is not far distant when this method of forming bulbs will entirely give place to the quicker and more suitable method of "pot-blowing."

Chapter xi. is headed "Sealing in," and contains some good drawings and descriptions of the methods used for fixing the filaments in the glass bulb. The small annealing oven to stand on the workman's bench, and receive the lamps as they are finished, is a very useful piece of apparatus, and is a great advance upon the old method of holding the work in a smoky flame, a practice which is not only dirty, but wastes both time and gas.

Touching upon glass grinding and the manufacture of taps, it is remarked that good taps can be bought cheaply made of German glass, but there is very great difficulty in joining them to the lead glass used in the exhausting apparatus. It is not generally known that this can be easily and effectually done by interposing between the German and the lead glass a thin stratum of soft white enamel or "arsenic" glass, used as a solder. Compound joints made in this way are perfectly sound, and are not at all liable to crack.

The important subject of exhausting is treated of in chapter xii. and it is pointed out that to produce a good lamp a high vacuum is absolutely necessary. The reasons against leaving a residual atmosphere of nitrogen or other inert gas are discussed, and then follows a complete description of the various forms of mercurial pumps in use. Several kinds of short-legged pumps are shown and described in detail. The "Sprengel pump" does not hold the prominent place it occupied some years ago, preference being given to the various forms of Geissler pump. The reason for this may lie in the great number of india-rubber joints that appear to be used. This way of making pumps always gives constant trouble through leakage, and poor efficiency is unavoidable. We cannot agree with the author that india-rubber joints are to be allowed. There is no doubt that india-rubber joints are almost universal in modern lamp factories, but we have equally little doubt that the short life of many of the lamps now on the market is due to imperfect exhaustion; and having had considerable experience in high vacua, we have no hesitation in saying that a vacuum sufficiently good for a long-lived incandescent lamp can only be obtained if all the joints are hermetically sealed together. We have still in use lamps dating from 1882 exhausted properly with sealed joints, and they have outlived generations of bought lamps made with the use of india-rubber joints.

For testing the vacuum the McLeod gauge is noted, but is not considered to be of much use to the lamp-maker. The size of the bubble in the chamber of the "Geissler," and the appearance and "hammer" of the mercury in the legs of the "Sprengel," are taken as sufficiently good indications for the purpose. This certainly savours of the "rough and ready" method, but in the absence of

any good indicator it probably answers the purpose. The coil test is mentioned, but it is very properly pointed out that the appearance of the luminosity in an exhausted bulb is not "under all conditions an indication of the state of the vacuum."

A good chapter is devoted to the testing of voltage and candle-power. The methods of using the photometer are fully described; the "Harcourt" pentane lamp is said to make the most trustworthy standard, but for regular factory use an argand burner with a Methven screen is recommended. This is occasionally tested with the pentane lamp. Then follows a full description, with drawings, of Evershed's wattmeter; and the chapter closes with a method of finding the mean horizontal candle-power of lamps with either flat or cylindrical filaments.

A short description is given of the method of capping the finished lamp. The author finds that the addition of a small percentage of dextrine to the plaster of paris makes a very hard cement, and he warns makers against using an acid flux for soldering the wires and connections. Nothing but rosin should ever be used.

In the chapter on efficiency and duration, allusion is made to the expression "watts per candle-power," instead of the more correct term "candle-power per watt," pointing out that it is more easy to grasp the meaning of a certain number of watts than of a particular fraction of a candle-power. In connection with duration tests, it is very justly said that "life tests pure and simple" are worthless unless the actual candle-power of the lamp at different periods of its life are given.

In the life of a lamp the advantage of the hard coating of deposited carbon shows itself. This hard carbon, combined with a good vacuum, greatly retards the falling off of candle-power due to the blackening of the bulb. It is explained that the disintegration of the carbon acts in three ways. Firstly, by coating the glass with deposited carbon and thus obscuring the light; secondly, by altering the surface of the filament and increasing its emissivity so that it is at a lower temperature; and thirdly, by increasing its resistance so that it takes less current. The data of experimental tests on several lamps for efficiency and duration close the chapter.

The last chapter takes up the relation between light and power in incandescent lamps, and details are given of the recent tests made under the direction of Prof. Ayrton at the City and Guilds of London Institute, with drawings of curve diagrams showing the candle-power and watts of lamps of various makes, up to the breaking point. In conclusion it is said that the ideal lamp would be one in which the radiation is wholly luminous, and that the carbon incandescent lamp falls very short of this desirable consummation. Brief reference is made to the beautiful experiment of Nicola Tesla.

On the whole, readers will find the book to be of very considerable interest, dealing as it does with an entirely new industry of very great elegance; and the practical knowledge diffused by its publication will certainly help to advance the evolution of an efficient lamp which can be sold for a reasonable price.

ALGEDONICS.

Pain, Pleasure, and Aesthetics; an Essay concerning the Psychology of Pain and Pleasure, with special reference to Aesthetics. By Henry Rutgers Marshall, M.A. (London: Macmillan, 1894.)

ALGEDONICS is the term which Mr. Marshall suggests for the science of pain and pleasure. In his sixth chapter he gives the derivation of the term thus: "*άλγος*, [pleasure; *ἡδονή*, pain"; the discovery of which, when he glanced over the pages of the completed volume, must, we fear, have given him an algedonic thrill. There is good stuff in the work, and the author is evidently well up in the literature of his subject.

In the first chapter, on the classification of pleasure and pain, Mr. Marshall discusses the psychological status of algedonic states. He argues, successfully we think, against the view that pleasure and pain are psychical elements *sui generis* with special nerves and specialised cerebral centres; and for the view that they are due to algedonic tone associated with any or all of the psychical elements. "Pleasures and pains," he says, "may be differential qualities of all mental states of such nature that one of them must, and either of them may, under proper conditions, belong to any element of consciousness." In his discussion, however, he does not bring out the fact, which is readily explicable on his view, that in popular speech we apply the term pain to the somewhat heightened affections of common sensibility, even when these affections are pleasurable. If, for example, we lightly touch a slight bruise, we term the sensation pain; but such "pain" may be, if we can trust our own experience, distinctly pleasurable. Since the fibres by which impulses from the nerve endings of common sensibility are transmitted, have special cortical endings, and seem to run, in part at least, along different tracts or in a different manner in the spinal cord, some colour has been lent to the view, that there are specialised fibres and centres for pain. If, however, such "pain" is merely the algedonic tone of common sensibility (as hinted, but not in so many words, by Mr. Marshall, on p. 18), these observations are quite in accordance with the view which our author advocates. Mr. Marshall quotes Mr. Herbert Spencer's opinion that "a relation proves itself to be itself a kind of feeling—the momentary feeling accompanying the transition from one conspicuous feeling to another." The word "feeling" is here used in its most general sense as an affection of consciousness. But Mr. Marshall appears to miss the importance of the fact that such feelings of relation have their algedonic tone no less than sense-impressions, a realisation of which would, we think, have helped him in his consideration of aesthetics.

In accordance with the view adopted in chapter i., we find that the emotions are regarded in the second chapter as deriving their character from the algedonic tone of complex co-ordinations of motor activity. Describing the psychological equivalents of these complex co-ordinations as, in their sensation aspect, "instinct-feelings," he regards them in their algedonic aspect as emotions. But here again he is rightly anxious to lay stress upon the fact, that the emotions, like pleasure and pain, are not some-

thing apart from but are inseparably bound up with sensory complexes. It is probable that the difficulty or impossibility of the psychological analysis of emotional states is due to the fact that their synthesis is effected in the physiological field below the threshold of consciousness, so that consciousness can deal only with the net result of inherited physiological co-ordinations—a view which is, again, in full accord with Mr. Marshall's own conclusions.

We must pass over the interesting discussion of "a group of co-ordinated activities tending to bring about attraction of other individuals," which Mr. Marshall terms the art-impulse, artistic creation having this end in view, though not cognised as the end. His contention is to some extent corroborated by that thirst for appreciation and recognition which forms part of the artistic temperament, and it harmonises with many observations on animal activities.

Coming now to the field of æsthetics, the author seeks to find some criterion by which æsthetics may be differentiated from algedonics. The conclusion to which he is led is as follows:—"That object is to be considered beautiful which produces a psychosis that is permanently pleasurable in revival," while "that object is to be considered ugly which produces a psychosis that is permanently disagreeable in revival." Thus "only those pleasures are judged to be *æsthetic* which (relatively speaking) are permanently pleasurable in memory." We believe that the author is here on the road to, but falls somewhat short of, the true criterion of æsthetics. The key of the problem, we think, lies in the recognition of the algedonic tone of *perceived relations*. It is this super-added element which raises the algedonics of sensory experience to the level of æsthetics. The æsthetic effect of the geometrical tracery in the chapter-house of Wells Cathedral is due to the emotional tone associated with perceived relationships. And it is just because in memory the relationships with their emotional tone are more abiding than the sense-elements, that to be permanently pleasurable in revival becomes a criterion of æsthetics. This criterion is, however, secondary. The primary criterion is the perception of relations with its associated emotional tone.

It is difficult to do justice, in the short space which remains to us, to the author's views as to the physical basis of pleasure and pain. These primitive qualities of psychical states are conceived to be "determined by the relation between activity and capacity in the organs, the activities of which are concomitants of the psychoses involved." When an organ during rest has stored up energy, the response of the organ to stimulus is pleasurable. But when the organ is spurred to activity beyond the limits of its stored-up energy, its functioning is painful. "Pleasure thus results when the balance is on the side of the energy given out, and pain when the balance is on the side of the energy received. Where the amounts received and given have equivalence, then we have the state of indifference." We have seen that Mr. Marshall does not accept the hypothesis that there are separate end-organs, nerve fibres, or cerebral centres for pleasure and pain. Unless, therefore, there is a qualitative difference in the impulses transmitted from an organ according as it is well-stored with energy or exhausted,

a position which is hardly tenable, the algedonic tone must be due to quantitative difference—that is to say, difference in the intensity of stimulus. Hence it would be better, so far as the organ is concerned, to lay the primary stress on the intensity of stimulus therefrom, and to make the state of the organ a condition of this intensity. Mr. Marshall ought also, we think, to supplement his view by reference to the condition of the cerebral centre concerned. The condition of the centre is possibly of even greater importance than the condition of the organ from which afferent impulses are transmitted. We cannot, however, further discuss the question here, and must refer our readers to the author's own treatment of the question in the fourth and fifth chapters of his work.

Although we do not agree with all his conclusions, we have no hesitation in saying that the book is written in the right spirit and on right lines. Fully aware of the necessity for careful introspection, he sees that the results so reached must be correlated with the conclusions arrived at through the investigations of the physiologist. It is only where the two modes of investigation thus go hand in hand that progress in psychology can be secured.

C. LI. M.

OUR BOOK SHELF.

Physiology Practicum. By Burt G. Wilder, Professor of Physiology, Vertebrate Zoology, and Neurology in Cornell University, U.S.A. (Published by the Author, 1893.)

THESE consist of a series of twenty-seven plates, with accompanying descriptions (large octavo), said by their originator to embody "explicit directions for examining portions of the cat, and the heart, eye, and brain of the sheep, as an aid in the study of elementary physiology." The author is well known in anatomical circles as the founder of a notoriously ambitious terminology, not wholly destitute of useful points. The present venture has furnished him a new peg upon which to hang this, and his title savours of the kind of treatment which the subject receives at his hands. Plate xviii. Fig. 19 (which deals with the "pelvic viscera, etc." [*sic*], of the female cat), and Plate xiii. Fig. 14 (which is said to represent the "head and neck of cat partly dissected"), may be taken as fair examples. With their faulty delineation of things which may be at once determined from descriptions alone, their ugly letters sprawling over them, and their apologetic descriptions, they are useless and uncalled for; and the matter is the more nauseous, as more than one finished anatomical treatise happens to deal with this animal. We put the plates down with the feeling that they are calculated to repel rather than encourage the student, and that although they may be of service in the work of the Cornell University, in connection with which they have arisen, there would be cause for alarm should they be adopted elsewhere.

The Fauna of British India, including Ceylon and Burmah. Published under the authority of the Secretary of State for India in Council. Edited by W. T. Blanford. "Moths." Vol. ii. By G. F. Hampson. Pp. xxii. 609, (325 woodcuts). (London: Taylor and Francis, 1894.)

THE second volume of Mr. Hampson's important work on the moths of India includes the *Arctiidae*, *Agaristidae*, and the bulk of the *Noctuidæ*, and considerably exceeds the first volume in bulk, 1545 species being described in vol.

ii. as against 1158 in vol. i. Under *Arctiida* the author includes the following groups as sub-families, which have usually been treated as families by previous authors:—*Arctiina*, *Lithosiina*, *Nycteolina*, and *Nolina*. The *Agaristidae* are a small family of handsome day-flying moths, and certainly look rather out of place in the position which they occupy in this book. The extensive family of *Noctuidae* is divided into ten sub-families (*Trifina*, *Acontiina*, *Palindiina*, *Sarothripina*, *Euteliina*, *Stictopterina*, *Gonopterina*, *Quadripina*, *Focillina*, and *Deltoidina*), of which the two last are held over to the forthcoming third volume of the book.

Concerning the *Noctuidae*, Mr. Hampson remarks, "The lowest forms are those of which the larvæ have five pairs of abdominal prolegs, and the perfect insects have vein 5 of the hind wing fully developed, and from the centre of the discocellulars, this ancestral form being only found in some *Deltoidina* and *Sarothripina*."

As the plan of the second volume is identical with that of the first, which we had the pleasure of noticing in *NATURE* for February 23, 1893 (pp. 387-388), we need only add that there seems no falling off in its execution. It is hoped that the third volume, including the *Epicopiidae*, *Uraniidae*, *Epiplemidæ*, and *Geometridæ* will be completed in the course of the present year.

W. F. K.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of *NATURE*. No notice is taken of anonymous communications.]

Panmixia.

MR. ROMANES has requested those students of natural history who cannot accept the doctrine of Panmixia to show the error which they believe to lie in his reasoning. I therefore ask leave to explain why I am unable to accept either the first proposition put forward by Mr. Romanes in *NATURE* of to-day, or the doctrine itself. Mr. Romanes says:—

The survival-mean must (on cessation of selection) fall to the birth-mean, &c. This statement involves neglect of a way in which selection may, and often must, operate. A simple example will show this. The mean height of adult Englishmen is roughly 67½ inches; and if I offer to enroll in a regiment every adult Englishman who is more than 66 and less than 69 inches high, the mean height of my regiment will, as every statistician knows, be still 67½ inches, but I shall be obliged to reject more than half the population. A form of selection, involving the destruction of more than half the population, may therefore occur without affecting the mean value of the character selected. I hope shortly to publish evidence, based on the measurement of many thousands of animals of one species, at many stages of growth, showing that selection does in fact operate in this way in particular cases. That it must so operate in many cases is obvious from the fact that many wild animals remain for several generations without sensible change in their mean character. In these cases either selection acts as I suggest, or it is incapable of affecting a change in the mean, or it does not act at all.

The second and third propositions put forward by Mr. Romanes are not demonstrated by any statistics with which I am acquainted; and with regard to the extreme statement that "any failure in the perfection of hereditary transmission will be weeded out" by selection in a wild state, I would urge the need, which has lately been well pointed out by Bateson, of a quantitative measure of the efficiency of selection. The frequency of even considerable abnormalities in specialised organs of wild adult animals, of which so many admirable examples are described in Mr. Bateson's recent work on variation, show, if it needed showing, that natural selection is in most cases an imperfect agent in the adjustment of organisms.

But my main difficulty is that neither Mr. Romanes, nor Prof. Weismann, nor any other advocate of the doctrine, has shown

that in some given case Panmixia does in fact occur, and that the results predicted are in fact produced. On the other hand, Mr. Galton has shown that civilised Englishmen are themselves in a condition of Panmixia, at least with respect to several characters, especially stature and the colour of the eyes. Now the mean stature of Englishmen is known to be slowly increasing, and there is no evidence of the disappearance of coloured eyes.

My objections to the position of Mr. Romanes and others are therefore two: first, that it is based on the assumption that selection, when acting on a species, must of necessity change the mean character of the species—an assumption incompatible with the maintenance of a species in a constant condition; and secondly, that in the only case which has been experimentally investigated, the consequences said to result from a condition of Panmixia do not, in fact, occur.

W. F. R. WELDON.

University College, London, April 26.

On Some Sources of Error in the Study of Drift.

As a general rule we may feel sure that the boulders scattered over the surface of a district which consists chiefly of boulder clay, have been derived from the underlying deposit. There are, however, some cases in which the inference is unsafe. For instance, the Thames now marks the southern limit of the glacial drift—a curious circumstance, and one of which a wholly satisfactory explanation has not been given. Many think that this sharp definition of the southern limit of the glacial drift is so improbable that they would fain attribute some deposits in North Kent to the glacial period, or at any rate would expect to find a few sporadic boulders stranded on the slopes of the North Downs; and there far-transported fragments do not unfrequently occur.

But there is this great source of error. All along the lower Thames barges carry refuse and rubbish of every description from London, and this is taken, such as it is, and laid on the adjoining lands.

So you find carried on, with road scrapings, fragments of every kind of road metal; with soil turned out in digging foundations, specimens of all the materials used for building; with the contents of middens, every variety of object of domestic use or ornament. It is marvellous what large lumps get on to the land in this way. When, then, anyone produces a specimen, even a large specimen eight or ten inches in diameter, and perhaps taken out of a deep loam, the evidence is rejected. The stone may have been carried on to the land with the manure, and the loam may in that district be quite recent rainwash. It may be that some of them were really of glacial origin, but all are equally distrusted. Some of them certainly cannot be referred to ice action. I have seen large pieces of Napoleonite found on the surface in North Kent. By what accidents they came to be there we cannot tell, but we may, at any rate, acquit the ice of having had anything to do with the transport of that peculiar Corsican rock.

When walking along the base of a cliff of boulder clay, we may generally infer that the far-travelled boulders that lie at its base have just been washed out of it. In most cases they have been; but in some, and those often the cases in which it is of greatest consequence to have the origin of the boulders clearly established, we have another serious source of error, of which I have just seen a good example.

A Norwegian vessel, carrying timber from Christiansund to Boston, in Lincolnshire, ran aground and became a total wreck off Old Hunstanton last winter. I saw her in January. The vessel looked sound enough to a landsman's eye; but she was dimasted and gutted, and the salvage was on the sand dunes close by. About her a pool of varying breadth had been formed by the swirl of the water round the hull. The currents had been deflected by various circumstances here and there, as especially where a quantity of ballast had been thrown out. This consisted of large boulders of various kinds of gneiss and porphyry, and the weighty pile looked as if it were little affected by the currents of the incoming and receding tides.

In April, I visited the spot again, expecting to find that the boulders had been driven along the shore by the fierce storms which had raged along that coast since my previous visit, and intending to make note of their dispersal and the distance to which they had travelled. I found, however, that the keel and a portion of the lower part of the wreck remained, and that the surrounding pool was greatly deepened and extended.

Through the deep clear water I saw the heap of ballast, which had been undermined and was settling down into the depths, being already far below the level of the surrounding sand. When the last of the timbers shall have yielded to the axe and the waves, the sand will soon level up the hole caused by the scour round the obstructing mass, and this heap of Scandinavian boulders will lie buried in the sand till some exceptional storm shall shift the banks, and expose them again, and perhaps transport them along the shore.

Had this vessel been thrown on a hard rocky shore instead, the ballast would have started at once with the other boulders on the shore, and been scattered, according to size and form, along the coast. As it was, however, these have got buried deep in sand, and preserved till, perhaps, the habit of using such boulders for ballast shall have been given up, and then, washed out by the accidents of weather, of coast destruction, and of shifting sand, they will appear among the fallen fragments of a boulder clay cliff, and be appealed to in proof of its origin.

How many ships with Scandinavian ballast have been wrecked along our eastern coast ever since the time of the Vikings? How many hundred tons of such boulders are still travelling round our shores?

Another source of error I observed, this spring, along the Norfolk coast near Lowestoft. A perpetually changing undercliff is formed by slips along the base of the cliffs. When the wind blows hard from the north-east, the shingle is thrown up against these broken masses, and much of it rests on the ledges and terraces at various heights above the sea. Shells are tossed up still higher, and gravel and sand from the upper part of the cliff slide and pour down, and find a resting-place here and there on its irregular face. When all these various processes are seen going on around, and the easily identified patches of recent shingle and shells or ancient sand and gravel can be observed, with their track from above, or their obvious equivalent below, there is not likely to be any difficulty. But when, in subsequent storms, landslips have covered these diversified patches with the samples of the various deposits that make up the cliffs on that changeable coast, the interpretation is not always so clear. Here we find in the boulder clay a mass of gravel with shells derived largely from the crag, there a streak of shelly sand tossed up from the recent shore, and covered by a slipped mass of boulder clay. Large boulders from the glacial drift lie side by side with others that have travelled along the shore from buildings or from wrecks; the explanation of the companionship being here and there given by the occurrence of a tobacco-pipe or the thick end of a glass bottle.

These are some of the more recent sources of error in our attempts to learn the history of deposits from their boulders. We must remember also in East Anglia that much of the drift is derived from cretaceous boulder-bearing beds, and where these appear sporadically in the drift they cannot be distinguished from others which the ice has received first hand from the parent rock—except when clear traces of glaciation have been preserved. It is not enough, therefore, to record that a boulder has been found on such a shore, or even in such a cliff, unless the observer has been careful to note the exact conditions and the surroundings of each find.

Cambridge.

T. MCKENNY HUGHES.

On the Tritubercular Theory.

In a brilliant address, read last year before the American Association for the Advancement of Science,¹ Prof. H. F. Osborn has brought together and laid before us the latest results of American research to which Mammalian Palæontology owes so much. Necessarily much space is given to the exposition of the theory of the development of the cusps of mammalian teeth. Never before has the tritubercular theory been so lucidly explained, so logically followed out; never before have its weaknesses been so obvious, its errors so plain.

Prof. Osborn first calls attention to "Cope's demonstration of the tritubercular molar as the central type in all the mammalia" as "a great step forward. In looking over the odontographies of Cuvier, Owen, Tomes, and Baume, we find there is no suspicion of this common type around which the highly

diverse mammalian molars centre." Further on he states that "all the specialised mammalian series, ungulates, primates, carnivores, insectivores, rodents, and marsupials are found playing similar, yet independent adaptive variations upon one type," that of the Marsupials and Placentals "every known triassic, Jurassic, cretaceous, and basal eocene fossil (excepting *Dicrocynodon*) is in some stage of tritubercularity," and that he is "able to bring forward evidence that the multitubercular molar instead of being primitive was derived from the tritubercular." In short, the arguments from palæontology and embryology in favour of considering the tritubercular pattern of molar as the primitive type are forcibly put before us. The place occupied by this common type amongst teeth, is compared to that held by the pentadactyle type in the morphology of the limbs of the four-footed vertebrates. What tritubercularity is for the teeth, "pentadactyly has long been for the feet," and later, "the molars of the clawed and hoofed mammals can now be compared, as we compare the hand or foot of the horse with that of the cat, because they spring from a common type." At the risk of being tedious, I have thought it necessary to give all these quotations to make Prof. Osborn's position quite clear.

What is our astonishment, then, when a little further on we come upon the statement that, "upon the polyphyletic theory of the origin of the mammals here advocated [namely, the independent origin of the Monotremes, Marsupials, and Placentals from a common ancestral stock, the Pro-mammalia], we must admit, first, the independent evolution of tritubercularity in different phyla; and second, the branching off of several great groups in the pre-tritubercular stages." (!) We are then told that the Prototheria, the Metatheria, the Insectivora, and the higher Placentals have all independently, and more or less rapidly, entered "into tritubercularity."

How do these statements agree with the evidence mentioned above? What becomes of the comparison with foot structure? Are we to believe that the pentadactyle limb has been considered to be the common or central type, because the various vertebrate groups have acquired it independently? The words "common" and "central," as applied to a type of structure, have no significance nowadays unless equivalent to ancestral. It seems hardly necessary to point out that such mythical types hovering over organs, and compelling them to assume a certain form, have no place in modern biology. We might be willing to accept the tritubercular as a generalised, archaic, or ancestral type; but it is out of the question, at the same time, to claim that it has been independently acquired by the groups in which it occurs. Could the divergence in general structure, and habits within the Marsupials, and the Placentals, lead to a convergence to one type of tooth? And, more extraordinary still, to the same type in both cases?

Moreover, many of the mammals, which, according to Prof. Osborn, so readily pass "into tritubercularity," only do so, apparently, to pass no less readily out of it. According to this theory the living forms which possess triconodont teeth, amongst the Marsupials on the one hand and the Placentals on the other, have been derived from ancestors with triconodont molars, which passed through the tritubercular, and again back into the triconodont type.

There is a very grave objection to such a fickle mode of cusp development, which seems to have escaped the notice of the supporters of the theory. All the various types of teeth met with amongst the mammalia are adaptations to particular kinds of food, and methods of feeding; the appearance or disappearance of a few cusps here and there may seem a matter of trivial importance to anyone forming a theory of cusp development, but there is no reason to think that it is so to the animal which possesses the teeth. The independent passage of all these groups of mammalia through a triconodont stage would imply, that they all and severally took to a particular kind of food (that for which the triconodont molar is an adaptation), and again their passage into a tritubercular stage would imply, that they afterwards took to another method of feeding (that for which the tritubercular molar is an adaptation). It is evident that the difficulties encountered in the attempt to derive the tritubercular tooth from a triconodont form in each group are overwhelming; we must, therefore, fall back on the supposition that the original mammalian teeth were provided with many cusps, not placed in one line, and the exact pattern of which remains still to be found.

There is much evidence for the view that the upper molars of the Pro-mammalian ancestor were of the tritubercular, and the

¹ "The Rise of the Mammalia in North America," Studies from the Biol. Laboratories of Columbia College, *Zool.* vol. i. 1893; reprinted in *NATURE*, Nos. 1262 and 1263, vol. xlix. 1894.

lower molars of the tubercular-sectorial types¹; in fact, I think, we cannot do better than accept Prof. Cope's generalisation,² if not as a definitely established theory, at all events as an excellent working hypothesis, "that the superior molars of both ungulate and ungulate mammalia have been derived from a tributercular type; and that the inferior true molars of both have been derived from a tubercular-sectorial type." These, indeed, are the types which occur most constantly amongst the earlier fossil forms, and the most primitive living representatives both of the Marsupials and Placentals. The Pro-mammalia, when they first arose as a small group struggling amongst their reptilian and amphibian rivals, very possibly adopted some method of feeding for which teeth of these or similar patterns were well adapted. Subsequently, with increasing number and divergence, just as in the pentadactyle limb some digits have been lost and others become unduly developed, the tributercular teeth have been modified to suit various needs; with this difference that, although digits are not easily added, new cusps often have arisen in the course of adaptation.

Oxford, April 21.

E. S. GOODRICH.

Zoological Regions.

WITH reference to the paper of Mr. Wallace in *NATURE* (vol. xlix. page 610), I agree with Mr. Wallace's aim and with his estimate of the importance of the subject.

A naturalist, who deals with a single large genus as *Pedicularis*, makes his own map, showing the distribution of the species and his own view of the lines of descent of his sections in geologic periods. He cannot do this on a map showing the division of the world into six biologic regions according to the Mammalia in them. Or, at all events, none of our monographers, so far as I know, has done it. The difficulty in dealing with a whole natural order is still greater.

The consequence is that, if some other botanic writer wishes to compare the distribution of *Pedicularis* with that of some allied genus, or to give a view of the distribution of the sub-order to which *Pedicularis* belongs, he cannot make any use of the results of the *Pedicularis* monograph without taking it all to pieces and re-arranging the whole material. This is in every case a laborious, in many cases an impossible task.

I therefore agree with Mr. Wallace that we require a division of the globe into "areas absolutely defined, easily remembered," so that, after the monographer has treated his genus or order in natural regions, he may also "tabulate" his facts on these standard areas; in order that his numerical results may be (at least in the rough) accessible for immediate use by others who may not have time (or sufficient special knowledge) to get up the monograph.

It is evident that Mr. Wallace has overlooked my paper on biologic regions and tabulation areas in *Trans. Linn. Soc.* vol. clxxiii. [1892] (B) pp. 371-387. Otherwise he could hardly have written (*NATURE*, vol. xlix. p. 612) that his regions readily enable us to tabulate the distribution of a group (and many other statements). In my paper I have pointed out that where I know, as in the case of many Sikkim plants, the exact boundary line of distribution of many species, I cannot tell whether these should be tabulated in Wallace's Region 1, or in his Region 3, or in both. The number of species which are in this predicament is so great that by exerting a choice how I would tabulate them I could bring out any result that might be wished. The more accurately I know the distribution of a species the more impossible is it for me to tabulate it on Wallace's map. And the more perfectly a region is biologically laid down (with peninsulas, islands, &c.) the more impossible it is to use it as an "area" for tabulating on. But, I must not trouble you with a recapitulation of my paper above cited, to which I refer Mr. Wallace and others who may be interested.

C. B. CLARKE.

Kew, April 30.

The Earthquakes in Greece.

THE severe earthquake felt in Greece on April 27 at 9.20 p.m. was observed in Birmingham by the aid of a delicate bifilar pendulum, with which observations are now being made

¹ In a former paper, "On the Fossil Mammalia from the Stonesfield Slate" (*Quart. Jour. Micr. Sci.* xxv. 1894), I brought forward some additional evidence in favour of this theory.

² "On the Tributercular Type of Molar Tooth in the Mammalia" (*Proc. Am. Phil. Soc.* 1893), and "Origin of the Fittest."

on behalf of the Earth Tremor Committee of the British Association. This instrument, designed by Mr. Horace Darwin, and made by the Cambridge Scientific Instrument Company, is described in the Report of the Committee presented at the Nottingham meeting last year.¹ I may merely mention here that a tilt of the ground in an east-west direction is magnified about 3000 times by the rotation of a mirror about a vertical axis; and that the image of a fine wire in front of a movable gas-jet, after reflection by the mirror, is observed in a fixed telescope in the passage outside the cellar in which the pendulum is erected.

Shortly before 8 p.m. (Greenwich mean time), I went down to take the usual reading, and found the image of the wire moving slowly from side to side of the field of view, showing that the ground was rocking gently backwards and forwards, the time of a complete pulsation being from twelve to fourteen seconds. It was difficult under the circumstances to make any exact measurements, but the maximum east-west component of the tilting cannot have been less than a quarter of a second. The pulsations were first observed at 7h. 59m., and my impression is that the range slightly increased until 8h. 3m. It then rapidly diminished, being about $\frac{1}{10}$ of a second at 8h. 12m., and never less than $\frac{1}{10}$ of a second until 8h. 28m., after which the pulsations ceased to be perceptible.

The time given by the newspaper correspondents is, I suppose, Athens time, and corresponds to 7h. 45m. Greenwich mean time. The interval between the occurrence of the earthquake and the arrival of the pulsations in Birmingham was therefore not greater than 14m., and, the distance traversed being roughly 1550 miles, it follows that the average velocity of the pulsations cannot have been less than 184 miles per second.

Gillott Road, Birmingham, May 1.

C. DAVISON.

"Vermes."

I WISH to enter a protest against the continued use of the word "Vermes" as a term of systematic significance with the same value as "Mollusca," "Arthropoda," &c. Linnaeus used the term to include all soft-bodied invertebrates—i.e. everything then known except the Arthropoda (his "Insecta") and Vertebrata. Then Lamarck employed the word in a much more definite and unexceptional sense, to include the parasitic worms, the Chaetopoda being separated as "Annelida." But what do modern writers mean by "Vermes"? Why, it has nearly as indefinite a limit as that given to it by Linnaeus, for it is used to include almost any invertebrate animal—never mind its structure—which does not fit in the Mollusca, Arthropoda, Echinoderma, Coelentera, or Protozoa. In fact, the term, as employed in such authoritative publications as the *Zool. Record*, *Zool. Jahresbericht*, &c., as well as by Jackson in "Forms of Animal Life," and in Lang's text-book, &c., embraces all, or most, of the following groups of animals:—Cestoda, Trematoda, Planaria, Nemertina, Archiannelida, Chaetopoda, Hirudinea, Gephyrea, Polyzoa, Brachiopoda, Nematoda, Acanthocephala, Rotifera, Sagitta, Echinoderes, and sundry other small worm-like forms, and even Balanoglossus, and occasionally Chaetoderma and Neomenia.

I do not intend to enter into the classification of this heterogeneous assemblage of forms, nor need I do more than refer to the fact that definite terms with scientific limitations are in existence under which the members of the assemblage can be (and are) grouped.

I am perfectly ready to admit that "Vermes" may be a useful descriptive term, if used to imply a certain general form of body, as opposed to some other groups; but I do wish to urge the abolition of it from text-books or titles of papers by well-known zoologists. That the eradication of the word presents considerable difficulties, I am aware; since it is not in England alone that "Vermes" still holds sway, but in all the European countries the equivalents "Vers," or "Würmer," &c., are employed with a more or less equivalent indefiniteness. Nevertheless, several such terms have been abolished, and no one nowadays would think of speaking, even in a popular, still less in a scientific work, of "Radiata" or "Zoophytes" or "Infusoria," in the antique significance of these words.

Oxford, April 18.

WM. BLAXLAND BENHAM.

¹ An account of a new and improved form of the pendulum will appear shortly in *NATURE*.

On Iron Crows' Nests.

THREE years ago, the removal of an old tree in the Cossipore Ordnance Factory, near Calcutta, brought to light a singular bird's nest, composed mainly of bent and twisted fragments of stout iron wire, such as is used to bind up bundles of bar iron for transport. The pieces, which were all about as thick as stout telegraph wire, were of considerable length and weight, and were keyed together by their own irregularities; but as there was no evidence by which to identify the builder, I merely made a note of the circumstances.

Last year, however, attracted by the laboured flight of a crow carrying in its bill a very unwieldy and apparently heavy load, I watched the bird until, frightened by a passing object when about two feet from the ground, it dropped its burden, which I at once secured. I found it to be a piece of crumpled iron wire, which on measurement in my laboratory proved to be 23½ inches long between its apparent extremities (straightened out it measured 35½ inches in length), to have a diameter of 0.125 inches (= No. 11 B.W.G.), and to weigh 55.72 grammes, or nearly 861 grains. The bird was in the main road, about 300 yards from the site of the original nest.

This evidence as to the ownership of the nest, and of the weight which an Indian crow can carry, may perhaps interest some of your readers.

WALTER G. MCMILLAN.

Mason College, Birmingham, April 20.

Early Arrival of Birds.

MR. PRIDEAUX, in the last issue of NATURE, having recorded the unusually early arrival of the summer migrants in Surrey, it may perhaps be permissible to state the date of arrival here. The cuckoo, uttering its festive note, flew into a tree in my garden on March 25, attracting the attention of the whole household, and has been heard at intervals in the neighbourhood of Worcester ever since. The swallow and martin were here on the 4th inst., the willow warbler in the neighbourhood of Worcester ever since. The swallow and martin were here on the 4th inst., the willow warbler and the white-throat on the 7th, and the red-start on the 16th. Nidification was remarkably early this season. In my garden the long thrush, blackbird, and robin hatched out by March 30, and the missal thrush in an orchard close by was, as usual, earlier in its family arrangements. I heard the swift on the 26th inst. The spring flora was also early: lilac, hawthorn, bluebell, cowslip, primrose, wood anemone, spotted orchis, and orchis morio were in blossom on the 20th inst.; the sweet violet gone, and the dog violet blooming profusely in its place.

There is nothing wonderful in the cuckoo being here in March. The wonder is that it was then vocal.

J. LLOYD BOZWARD.

Henwick, Worcester, April 28.

Irritability of Plants.

IN your issue for April 19 (vol. xlix. p. 586) there is a short notice of a paper by Prof. Pfeffer on the "Irritability of Plants." In it you say: "Pfeffer instances the remarkable researches of Hegler on the effect of mechanical traction on growth stems, which when stretched by a weight, gain mechanical strength through the development of the mechanical tissues, which follows as a response to the pull to which they are subjected."

This recalls to mind the interesting passage in Tennyson's "Idylls of the King":

So Gareth ere he parted flash'd in arms.
Then as he donn'd the helm, and took the shield
And mounted horse and grasped a spear, of grain
Storm-strengthen'd on a windy site, and tip
With trenchant steel.

Derby, April 24.

R. M. DEELEY.

The Action of Light on the Diphtheria Bacterium.

SOME time ago it was reported that colonies of the diphtheria bacterium do not thrive well when exposed to light, and it occurred to me that the electric light might afford a means of checking the development of the false membranes by projecting a very powerful arc light on the throat, for it is known that the tissues are to some extent penetrated by light. Or possibly the arc light could be sent into the throat through the mouth? I know that in Germany microscopic objects have been lighted with the aid of a lamp

placed at some distance, and connected to the microscope by a curved glass rod, which conveyed the light by internal reflection. Incandescent lamps might be used in a similar manner, and some means could be devised in order to intercept the heat they produce, if it be objectionable.

A few days ago I noticed an article on Dr. Phillips' electric lamps, which he has employed to light the mouth, and the cavities between the mouth and the nose, and you recently published a paper read before the Royal Society, by Prof. H. M. Ward, on the bactericidal action of light, which partly confirms my views. It seems worth while, therefore, to make experiments with arc rays projected indirectly as above, and with incandescent lamps, and that especially upon diphtheria membranes.

J. EREDE.

Rome, April 18.

Centipedes and their Young.

IN No. 1275 of NATURE (vol. xlix. p. 531), Mr. Ulrich, of the Trinidad Field Naturalists' Club, asks for information about the breeding habits of centipedes.

Similar observations to those made by the members of the Trinidad Club, and described by Mr. Ulrich, have been published by Kohlrausch ("Beiträge zur Kenntniss der Scalapendriden." Diss., Marburg, 1878), and these are referred to in the standard work on Myriapoda by Latzel ("Die Myriapoden der Österreichisch-Ungarischen Monarchie." Wien, 1880, p. 136), and also in the "Lehrbuch der vergleichenden Entwicklungsgeschichte" (Jena, 1890), by Korschelt and Heider, p. 725.

Czernowitz, April 25.

R. v. LENDENFELD.

Marsupites in the Isle of Wight.

IN a recent visit to the Isle of Wight, plates of *Marsupites* were found by Mr. R. M. Brydone and myself at Freshwater.

The locality is one in which these fossils might be expected to occur, but so far as I know they have not been recorded hitherto from any part of the island; certainly not by Barrois, nor in the last edition of the "Survey Memoir."

Winchester College.

C. GRIFFITH.

POINCARÉ ON MAXWELL AND HERTZ.¹

AT the time when Fresnel's experiments compelled all researchers to admit that light is due to the vibrations of a very subtle fluid filling the interplanetary spaces, the researches of Ampère made known the mutual actions of currents, and founded electrodynamics.

But one step more was required to suppose that this same fluid, the ether, which is the cause of luminous phenomena, is at the same time the vehicle of electrical actions. This step Ampère's imagination enabled him to take; but the illustrious physicist, while announcing this seductive hypothesis, did not see that it was so soon to take a more precise form, and receive the beginning of its confirmation.

It was still, however, but a dream without consistence, till the day when electric measures indicated an unexpected fact—a fact recalled by M. Cornu in the last *Annuaire*, at the end of his brilliant article devoted to the definition of electric units. To pass from the system of electrostatic units to the system of electrodynamic units, a certain transformation-factor is employed, the definition of which I will not recall, as it is to be found in M. Cornu's article. This factor, which is also called the ratio of unities, is precisely equal to the velocity of light.

The observations soon became so precise that it was impossible to attribute this concordance to chance. One could not doubt therefore that there were certain intimate relations between the optic and the electric phenomena. But the nature of these relations would perhaps still have escaped us if Maxwell's genius had not guessed it.

¹ Translation of an article by M. Poincaré, in the *Annuaire* of the Bureau des Longitudes for 1894.

Currents.

Everyone knows that bodies can be divided into two classes: conductors where we prove the transference of electricity, that is to say, of voltaic currents, and insulators or dielectrics. To the old electricians dielectrics were purely inert, and their part consisted in opposing the passage of electricity. If this were so, we could replace any insulating body by another of a different kind without changing the phenomena. Faraday's experiments have shown that it is nothing of the kind. Two condensers of the same shape and dimensions put in communication with the same sources of electricity will not take the same charge (even if the thickness of the isolating wire be the same), if the *nature* of the isolating matter differs. Maxwell had made too deep a study of Faraday's works not to understand the importance of dielectric bodies and the necessity of restoring to them their proper function.

Besides, if it be true that light is but an electric phenomenon, it follows that when it is propagated through an insulating body, this body is the place of the phenomenon, therefore there must be electric phenomena localised in dielectrics; but of what nature are they? Maxwell answers daringly: they are currents.

All the experiments up to his time seemed to contradict this; currents had never been observed except in conductors. How could Maxwell reconcile his audacious hypothesis with such a well-founded fact? Why do the hypothetical currents under certain circumstances produce manifest effects, which under ordinary conditions remain absolutely unobservable?

It is because dielectrics oppose to the passage of electricity, not a greater resistance than the conductors, but a resistance of a different kind. A comparison will make Maxwell's thought clearer.

If we endeavour to bend a spring, a resistance is encountered which increases in proportion as the spring is bent. If, therefore, we have at our disposal only a limited force, a moment will come when the resistance being unsurmountable, the movement will stop and equilibrium be established; at last, when the force ceases to act the spring will bound back, giving back all the work expended to bend it.

Suppose, on the contrary, that we wish to move a body immersed in water. Here again we meet with resistance which will depend on the velocity, but which, if this velocity remains constant, will not increase in proportion as the body advances; the movement will therefore continue as long as the force acts, and equilibrium will never be attained; finally, when the force ceases to act, the body will not tend to return, and the energy used for making it advance cannot be restored; it will have been entirely transformed into heat by the viscosity of the water.

The contrast is manifest, and it is necessary to distinguish between *elastic* and *viscous* resistance. Then dielectrics would behave, for electric movements, like elastic solids in the case of material movements, whilst conductors would behave like viscous liquids. Hence two categories of currents: current of displacement or Maxwell's currents which traverse dielectrics, and the ordinary conducting currents which circulate in conductors.

The first, having to overcome a sort of elastic resistance, can be but of short duration; for, this resistance increasing continually, equilibrium will be rapidly established.

The currents of conduction, on the contrary, having to overcome a sort of viscous resistance, can consequently last as long as the electromotive force which causes them. Let us look again at the convenient comparison which M. Cornu has borrowed from hydraulics. Suppose we have water under pressure in a reservoir; let us put this reservoir in communication with a vertical tube; the water will rise in it, but the movement will stop

so soon as the hydrostatic equilibrium is reached. If the tube is large, there will not be any friction, or loss of charge, and water thus raised could be used for producing work. We have here a picture of displacing currents.

If, on the contrary, the water of the reservoir flows out by a horizontal tube, the movement will continue so long as the reservoir is not empty; but if the tube is narrow, there will be a considerable loss of work, and a production of heat by friction. We have here a picture of conducting currents.

Although it is impossible and of little use to try to represent to ourselves all the details of this mechanism, one may say that all happens as if the displacement currents had a number of little springs to bend. When the currents stop electrostatic equilibrium is established, and the springs are so much the more bent as the electric field is more intense. The work accumulated in these springs, that is to say, the electrostatic energy, can be wholly restored so soon as they can unbend themselves. It is thus that mechanical work is obtained when the conductors are allowed to obey the electrostatic attractions. These attractions would thus be due to the pressure exercised on the conductors by the bent springs. Finally, to follow the comparison to the end, the disruptive discharge must be likened to the rupture of overstrained springs.

On the other hand, the work employed for producing conduction currents is lost and wholly transformed into heat like that expended in overcoming the friction or the viscosity of fluids. *It is for this reason that the conducting wires get hot.* From Maxwell's point of view there are only closed currents. For the old electricians this was not so; they looked upon a current as closed which circulates in a wire joining the two poles of a battery. But if, instead of reuniting the two poles directly, one puts them in communication respectively with the two armatures of a condenser, the instantaneous current, which lasts until the condenser is filled, was considered open; it went, it was thought, from one armature to the other across the wire of communication and the battery, and stopped at the surface of the two armatures. On the other hand, Maxwell supposed that the current traverses the insulating plate, which separates the two armatures, under the form of a displacement current, and that it is thus completely closed. The elastic resistance which it meets on the passage explains its short duration.

Currents can manifest themselves in three ways: by their calorific effects, by their action on magnets and currents, by the induced currents to which they give rise. We have already seen why conduction currents develop heat, and why displacement currents do not do so. On the other hand, however, according to Maxwell's hypothesis, the currents which he imagines, must, like the ordinary currents, produce electromagnetic, electrodynamic, and inductive effects.

Why have we hitherto been unable to put these effects in evidence? It is because a displacement current, however feeble, cannot last long, in the same direction; for the tension of our springs, ever increasing, would soon stop it. There cannot therefore be in dielectrics, either continuous currents of long duration, or sensible alternating currents of long period. The effects will, however, become observable if the alternation is very rapid.

The Nature of Light.

According to Maxwell, this is the origin of light. A luminous ray is a series of alternating currents produced in dielectrics, or even in the air or the interplanetary vacuum, which changes its direction a thousand billion times every second. The enormous induction due to these frequent alternations produces other currents in the neighbouring parts of the dielectric, and it is thus that the luminous waves spread from point to point.

Calculation shows us that the rate of spreading is equal to the ratio of the units, that is to say, to the velocity of light.

These alternating currents are a kind of electrical vibrations; but are these vibrations longitudinal like those of sound, or transversal like those of Fresnel's "ether"? In the case of sound the air undergoes condensation and rarefaction, alternatively. On the contrary, Fresnel's ether, when vibrating, behaves as if it were formed of incompressible layers, capable only of sliding one over the other. If there were *open* currents, the electricity going from one extremity to the other of one of these currents would accumulate at one of the extremities; it would condense or rarefy itself like air; its vibrations would be longitudinal. But Maxwell admits only closed currents; this accumulation is impossible, and electricity behaves like Fresnel's incompressible ether; its vibrations are transversal.

Experimental Verification.

So we find again all the results of the undulatory theory. But this was, however, not enough to induce the physicists, who were more charmed than convinced, to accept Maxwell's ideas. All that could be said in their favour was that they did not contradict any of the observed facts, and that it was a great pity if they were not true. But experimental confirmation was wanting; it had to be waited for during twenty-five years.

A divergence had to be found between the old theory and Maxwell's, which was not too delicate for our rough means of investigation. There was only one which afforded an *experimentum crucis*.

The old electrodynamics required electromagnetic induction to be produced instantaneously; but according to the new doctrine it must, on the contrary, be propagated with the velocity of light.

The question was therefore to measure, or at least to ascertain, the rate of propagation of inductive effects; this has been done by the illustrious German physicist, Hertz, by the method of interferences.

This method is well known in its applications to optical phenomena. Two luminous rays issuing from the same source interfere when they meet at the same point after having followed different paths. If the difference of these paths is equal to the length of a wave—that is to say, to the path traversed during one period, or a whole number of wave-lengths—one of the vibrations is later than another by a whole number of periods; the two vibrations are therefore at the same phase, they are in the same direction, and they reinforce each other.

If, on the contrary, the difference of path of the two rays is equal to an odd number of half wave-lengths, the two vibrations are in contrary directions, and they neutralise one another.

The luminous waves are not the only ones susceptible to interference; all periodic and alternating phenomena propagated with a finite velocity will produce analogous effects. It happens with sound. It ought to happen with electrodynamic induction, if the velocity of propagation is finite; but if, on the contrary, the propagation be instantaneous, there will not be any interference.

But one cannot put these interferences to the proof if the wave-length is greater than our laboratories, or greater than the space that the induction can traverse without becoming too feeble. Currents of very short period are absolutely essential.

Electric Exciters.

Let us first see how they may be obtained with the help of an apparatus which is a veritable electric pendulum. Suppose two conductors united by a wire; if they are not of the same potential, the electric equilibrium is broken in the same way as the mechanical equilibrium is deranged when a pendulum is swung from

the vertical. In the one case as in the other, the equilibrium tends to re-establish itself.

A current circulates in the wire, and tends to equalise the potential of the two conductors in the same way as a pendulum seeks the vertical. But the pendulum will not stop in its position of equilibrium; having acquired a certain velocity, it passes this position because of its inertia. Similarly, when our conductors are discharged, the electric equilibrium momentarily re-established, will not maintain itself, and will be destroyed by a cause analogous to inertia; this cause is *self-induction*. We know that when a current stops it gives rise in the adjacent wires to an induced current in the same direction. The same effect even is produced in the wire in which the induction current circulates, which finds itself, so to speak, continued by the induced current.

In other words, a current will persist after the disappearance of the cause which produced it, as a moving body does not stop when the force, which had put it in motion, ceases to act.

When the two potentials shall have become equal, the current will therefore continue in the same direction, and will make the two conductors take opposite charges to those which they had to start with.

In this case, as in that of the pendulum, the place of equilibrium is passed; in order to re-establish it, a backward movement is necessary.

When the equilibrium is regained, the same cause immediately destroys it, and the oscillations continue without ceasing.

Calculation shows that the duration depends on the capacity of the conductors; it suffices, therefore, to diminish sufficiently this capacity, which is easy, to have an electric pendulum susceptible of producing alternating currents of extreme rapidity.

All this was well established by Lord Kelvin's theories and by Feddersen's experiments on the oscillating discharge of the Leyden jar. It is, therefore, not this which constitutes the original idea of Hertz.

But it is not sufficient to construct a pendulum; it must also be put into movement. For this, it is necessary for some agent to move it from its position of equilibrium, and then to stop abruptly—I mean to say, in a time very short in relation to the duration of a period; otherwise the pendulum will not oscillate.

If, for example, we move a pendulum from its vertical position with the hand, and then, instead of loosing it suddenly, we let the arm relax slowly without unclamping the fingers, the pendulum, still supported, will arrive at its place of equilibrium without velocity, and will not pass it.

We see then, that with periods of a hundred-millionth of a second, no system of mechanical unclamping could work, however rapid it might appear to us with regard to our usual units of time. This is the way in which Hertz has solved the problem.

Taking again our electric pendulum, let us make in the wire, which joins the two conductors, a cut of some millimetres. This cut divides our apparatus into two symmetric halves, which we will put in communication with the two poles of a Ruhmkorff coil. The induced current will charge our two conductors, and the difference of their potential will increase with a relative slowness.

At first the cut will stop the conductors from discharging themselves. The air plays the part of an insulator, and keeps our pendulum away from its position of equilibrium.

But when the difference of potential becomes large enough, the jar spark will pass, and will make a way for the electricity accumulated on the conductors. The cut will all at once cease to act as an insulator, and by a sort of electric unclamping, our pendulum will be freed from the cause which prevented it returning to its equilibrium. If the complex conditions, well

studied by Hertz, are fulfilled, this unclamping is sudden enough to enable oscillations to be produced.

The apparatus, called an "exciter," produces currents which change their direction from 100,000,000 to 1,000,000,000 times per second. Because of this extreme frequency they can produce inductive effects at a great distance. In order to render these effects simple, another electric pendulum, called a "resonator," is employed. In this new pendulum, the cut and the coil, which only serve for the unclamping, are suppressed; the two conductors reduce themselves to two very small spheres, and the wire is bent back in a circle in a way to approach the spheres to each other.

The induction due to the exciter will put this resonator in vibration the more easily as the periods of the two are less different. At certain phases of the vibration, the difference of potential of the two spheres will be large enough to produce sparks.

Production of Interferences.

We have thus an instrument which shows the effects of an inductive wave emitted from the exciter. We can study what happens in two ways: either expose the resonator to the direct induction of the exciter at a great distance, or else make this induction work at a short distance on a long conducting wire, along which the electric wave will go, and which will work in its turn by induction at a short distance on the resonator.

Whether the wave propagates itself along a wire or across the air, one can produce interferences by reflection. In the first case, it will reflect itself at the extremity of the wire, which it will follow again in an inverse direction; in the second, it will reflect itself on a metallic leaf which acts as a mirror. In the two cases the reflected wave will interfere with the direct wave, and we can find places where the spark of the resonator will cease to pass.

The experiments made with the long wire are easier; they furnish us with very precious instruction, but they will not serve as *experimenta crucis*; for in the old as well as the modern theory, the quickness of an electric wave along a wire must be equal to that of light. The experiments on the direct induction at a great distance are, on the contrary, decisive. They show that not only the quickness of propagation of induction across the air is finite, but that it is equal to the quickness of the wave propagated along a wire, complying with the ideas of Maxwell.

Synthesis of Light.

I shall insist less on other experiments of Hertz, more brilliant, but less instructive. Concentrating with a parabolic mirror the wave of induction taken from the exciter, the German savant obtains a veritable cluster of electric rays, capable of reflecting and refracting themselves regularly. The rays, if the period, already so small, were a million times shorter still would not differ from the luminous rays. We know that the sun gives out several kinds of radiation, some luminous because they act on the retina, others obscure ultra-violet or infrared, which manifest themselves by their chemical or calorific effects. The first only owe their qualities, which make them appear to us of a different nature, to a kind of physiological chance. To the physicist the infra-red does not differ more from the red, than the red from the green; the length of a wave is only greater; those of the hertzian radiations are much greater still, but there are only differences of degree, and one may say, if Maxwell's theories are true, that the illustrious Professor of Bonn has realised a veritable synthesis of light.

Conclusions.

But our admiration for so much un hoped-for success must not make us forget the progress which still remains

to be accomplished. Let us therefore try to exactly summarise the results which are definitely attained.

First, the velocity of direct induction across the air is finite, without which the interferences would be impossible. The old electro-dynamics are therefore condemned. What must one put in its place? Is it Maxwell's theory (or at least something approaching it, for one would not expect the divination of the English savant to have foreseen the truth in all its details)? Although the probabilities accumulate, the complete demonstration is not yet reached.

We can measure the length of a wave of hertzian oscillations; this length is the product of the period by the velocity of propagation. We should, therefore, know this velocity if we knew the period; but this last is so small that we cannot measure it; we can only calculate it by a formula due to Lord Kelvin. This calculation leads to numbers which agree with Maxwell's theory; but the last doubts will only be done away with when the velocity of propagation has been directly measured.

This is not all: things are far from being so simple as one might think, from the above short account. Diverse circumstances come to complicate them.

First, there is round the exciter a radiation of induction; the energy of this apparatus radiates, therefore, externally, and as no fresh source comes to supply it, it soon disperses, and the oscillations die out very rapidly. It is here that one must look for the explanation of the phenomenon of multiple resonance, which was discovered by MM. Sarasin and De la Rive, and which at first appeared irreconcilable with the theory.

On the other hand, we know that light does not precisely follow the laws of geometrical optics, and the difference which produces diffraction, is more considerable as the length of the wave is greater. With the great length of the hertzian undulations these phenomena must assume an enormous importance, and trouble everything. No doubt it is fortunate, for the moment at least, that our means of observation are so coarse, otherwise the simplicity which seduced us at the first sight would give place to a labyrinth where we should be lost. It is from this probably that different anomalies arise, which have hitherto not been explained. It is also for this reason that the experiments on the refraction of rays of electric force have, as I said above, but little demonstrative worth.

There still remains a difficulty which is more serious, but which is no doubt not insurmountable. According to Maxwell, the coefficient of electrostatic induction of a transparent body ought to be equal to the square of its index of refraction. This is not so; the bodies which follow Maxwell's law are exceptions. We are evidently in the presence of phenomena much more complex than we thought at first; but one has not been able to explain anything, and the experiments themselves are contradictory.

There still remains, therefore, much to be done; the identity of light and electricity is from to-day something more than a seducing hypothesis: it is a probable truth, but it is not as yet a proved truth.

THE RECENT WORK OF THE CATARACT CONSTRUCTION COMPANY.

SOME arrangements recently made by the Cataract Construction Company show that the works are extending in a very satisfactory manner. The Niagara Falls Paper Company is now well under way. They make paper from wood pulp, and a large amount of power is used for grinding the trees down into pulp. They have fixed turbines in their own wheel-pit, and take water from

the Cataract Construction Company's canal, and pass it after use into the tunnels belonging to this Company. The turbines drive a vertical shaft which, at the surface of the ground, is geared by bevel wheels to the main shaft, on which are the pulp grinders. This is the only case likely to occur where the power is used directly. In all other cases it is likely to be transmitted electrically. The first electrical application is to the works of the Pittsburgh Reduction Company for the manufacture of aluminium. The Niagara Falls Power Company has undertaken to supply them with continuous current at 160 volts to the extent of 7000 horse-power. The first 1500 horse-power is now being put in. In order to do this, Prof. Forbes has arranged to carry the alternating current by two circuits in two phases. This is the character of current generated by the dynamos. At the works, 2500 feet from the power-house, the current is to be transformed from 2000 volts to 115 volts alternating. It is then passed through three of the commutating machines, like those shown by Schuckert and others at the Frankfort Exhibition of 1891. These are continuous current machines, each with four rings attached to certain bars of the commutator. The alternating current is passed to these rings by brushes; the armature revolves synchronously with the generator in the power-house and with the turbine. The other brushes, which rub on the commutator, give off continuous current to the aluminium baths at 160 volts, the E.M.F. being (in normal conditions) raised in its change from alternating to continuous current in the ratio of $\sqrt{2}:1$. A shunt direct current with variable resistance in the circuit excites the field magnets. It is found that the electromotive force of the direct current can thus be regulated. The explanation of this remarkable fact has been worked out by Mr. Steinmetz. The whole of this plant, transformers, commutating machines, and switch-board was tendered for by different firms, and the bid of the General Electric Company has been accepted; 33 per cent. of spare plant is held in reserve. The dynamos and power-house switch-board, on the other hand, are in the hands of the Westinghouse Company. It is expected that both types of machinery will be in operation in the course of a few months.

The patent for Prof. Forbes' construction of dynamo, which is being built, has been just allowed by the United States Patent Office. One object to be attained was to have a fixed armature, so that the armature might be wound so as to give a very high E.M.F. without being subjected to the enormous centrifugal forces of the revolving part. Another object was to attain a maximum fly-wheel effect with a minimum weight. The revolving parts of the turbine and dynamo, and the vertical shaft connecting them, are all supported hydraulically by means of a piston in the turbine. The supporting power of this piston limited the weight of the revolving part of the dynamo to 80,000 lbs. The governor of the turbine demanded (to fulfil the required conditions of regulation) a momentum equal to that of 1,100,000,000 lbs., moving at the rate of 1 foot per second.

Both of these objects are attained by Prof. Forbes' construction, which consists in making the armature fixed and ring-shaped, with a space inside for getting at the bearings, and in making the fields of a bell-shape, the poles being on the inside of a nickel steel ring, which is supported by the top piece or cover, which in its turn is rigidly fixed to the vertical axis. This novel construction gives all the fly-wheel effect required without making the weight too great. Every design which had been made previously required the addition of a fly-wheel costing at least £800 or £1000. The construction for which Prof. Forbes' patent has now been granted has also the great merit that the magnetic pull between the armature and the fields tends to diminish the breaking strain of centrifugal force on the revolving part to a very

sensible amount. When the revolving part is inside the magnetic pull assists centrifugal force in its destructive effect.

THE EPPING FOREST CONTROVERSY.

THE meeting of the Essex Field Club, which, as we announced last week, had been convened for the inspection of the thinned districts of Epping Forest, was in every way a remarkable gathering. Nearly 150 members and visitors assembled in Monk's Wood, among them, in addition to the conductors and officers of the Club, being Sir John Lubbock, Mr. J. Bryce, M.P., Chancellor of the Duchy of Lancaster, Prof. Boulger, Prof. W. R. Fisher, Dr. Church, Mr. Arthur Lister, Mr. Andrew Johnston (chairman of the Essex County Council), Mr. David Howard, Mr. Salmon (chairman of the Epping Forest Committee), Sir Frederick Young, Mr. Bernard Gibson, and others interested in the question of the Forest management. A thorough examination of Monk's Wood was made, Mr. E. N. Buxton giving a detailed explanation of the policy which the Conservators had been pursuing, and pointing out the reasons that had led to the present necessity for thinning. The party were then conducted to Lord's Bushes, which, as an example of the beautifying effect of judicious thinning, is almost unrivalled, this district having been submitted to the operation repeatedly since the Forest was taken over by the present Conservators. After tea at the Royal Forest Hotel, Chingford, a meeting of the Club was held, Mr. F. Chancellor, the President, in the chair. The discussion was opened by Prof. Meldola, who commenced by explaining that the statements which had been inserted in the newspapers respecting the attitude taken by the Club in the present controversy had been made without authority, and were devoid of foundation. He then went on to show that the observations made by him in 1883 in connection with the agitation against the railway scheme with which the Forest had then been threatened (see the article quoted in our columns in last week's note), had recently been applied to the present thinning operations without his concurrence, and in direct opposition to the views which he had formed after five visits to the districts now being dealt with, and after an intimate acquaintance with the Forest for a period of more than twenty years. Having explained the general grounds on which he based his opinions, he stated that in his belief the Forest as a whole showed a marked improvement since it had been under the care of the present management, and he considered that much of the recent criticism had been most unjust, and the newspaper accounts exaggerated to an extent bordering on the ludicrous. Two or three speakers took an adverse position, but Prof. Boulger, Mr. Howard, Mr. F. C. Gould, Mr. W. Crouch, the President, Mr. William Cole, and others who knew the Forest well, expressed general approval of the recent operations. Mr. Angus Webster, the Duke of Bedford's forester, who accompanied the party, was of course obliged to reserve his opinion owing to his official connection with the committee of experts appointed by the Corporation, the report of this committee not having as yet been presented. As the outcome of the discussion, it may safely be said that the public will not be so ready in future to give credence to the opinions of irresponsible and inexperienced scribblers who, often with the best of motives, may seriously hamper the work of the Conservators in their endeavour to restore the Forest to a more natural condition in those parts which have for so many centuries been made unnatural and unsightly by the existence of the rights of lopping. Although it had not been the original intention of the officers and conductors to allow a formal motion to be put, a strong desire was expressed that this should be done, and on

taking a vote a large majority decided that some resolution should be framed. Not the least important feature of the meeting were the speeches made by Sir Frederick Young (formerly chairman of the "Forest Fund"), and others who had taken up an antagonistic attitude in the correspondence. Having visited the place and heard the explanations given on the ground, these gentlemen admitted that as the result of the afternoon's inspection they had seen good reason for modifying their views, and they finally voted for the following resolution, moved by Prof. Boulger and seconded by the Rev. W. C. Howell, of Tottenham:—"That in the opinion of this meeting the general action of the Conservators in the recent thinnings has been judicious." Forty-one voted in favour of this resolution, and eight against. The views of those whose opinions should count for much in reassuring the public that no alarm need be felt as to the future of the Forest, have thus been expressed in very decided terms.

THE UNIVERSITY OF LONDON.

A GENERAL meeting of the Association for Promoting a Professorial University for London, was held in the rooms of the Chemical Society, Burlington House, on Saturday, April 28; the Right Hon. T. H. Huxley was in the chair.

The committee reported that having carefully studied the report of the Gresham Commission, they considered it is generally in accord with the principles of the Association.

In accordance with this report a resolution, moved by Prof. Rücker, and seconded by Prof. Ramsay, was unanimously carried, expressing general approval of the scheme. The committee were also empowered to draw up a memorial to the Government, to be signed by members of the Association, and others who may agree with it, urging the Government to appoint a Statutory Commission to establish a Teaching University in London on the basis of the scheme of the Royal Commission.

This action on the part of the Association is, we hope, another step towards the realisation of the scheme of the "Gresham Commission."

It was at one time to be feared that it would be impossible to reconcile the various divergent views which had been expressed as to the best constitution for the University. Now, however, that the Colleges of Physicians and Surgeons, the Governing Body and Senate of University College, and the Professorial Association, have all expressed a general approval of the scheme, while the London County Council finds in it nothing inconsistent with its own views, it is evident that the Commissioners have achieved a remarkable success. The University of London has not yet spoken, but the opponents of the scheme in Convocation were unable to carry their resolutions, and it is to be hoped that the University may yet be saved from the discredit of blocking the way.

NOTES.

A STATUE of Durand-Claye, the pioneer of the system for the agricultural utilisation of sewage, was unveiled at Gennevilliers, on Friday last. The funds for the erection of this monument were raised by international subscription, in accordance with a proposal made at the Congress of Hygiene held in Paris in 1889.

We regret to announce the death, at Geneva, of the eminent chemist, J. C. Galissard de Marignac. We have also to record the death of Laureano Calderon, Professor of Biological Chemistry in Madrid University.

THE Kazan Society of Naturalists will celebrate the twenty-fifth anniversary of its foundation on May 25, by a general meeting of members, at which a statement will be read of the works published by the Society during its existence.

THE *Times* says that the Attorney-General has given his sanction to the sum of £25,000, the residue of the legacy of the late Mr. Richard Berridge, being given, in trust, to the British Institute of Preventive Medicine, for the endowment of a laboratory devoted to the bacteriological and chemical examination of the water supply, with special reference to the best means of preventing the conveyance of disease through water. A large laboratory is now in course of erection for the purpose on the site secured by the institute at Chelsea.

EARTHQUAKES continue to be felt in Greece. A severe disturbance, having its centre in Atalanti, occurred on Friday, April 27 (see p. 7), and the *Times* correspondent says that the inroads of the sea in this district have extended inland for a distance of three kilometres. The surface of the sea in many places is coloured with the products of submarine eruptions. A chasm has opened in the ground not far from Atalanti, and extends in a south-westerly direction for about twelve kilometres.

AT the anniversary meeting of the Zoological Society, held on Monday, Sir William H. Flower, K.C.B., F.R.S., was re-elected President, Mr. C. Drummond, Treasurer, and Dr. P. L. Slater, F.R.S., Secretary to the Society for the ensuing year. The following were elected into the Council, in the place of retiring members:—Dr. John Anderson, F.R.S., Mr. Herbert Druce, Sir Joseph Fayer, F.R.S., Major Henry P. St. John Mildmay, and Prof. A. Newton, F.R.S.

THE opening meeting of the British Association this year will take place on Wednesday, August 8, when Prof. Burdon Sanderson, F.R.S., will resign the chair, and the Marquis of Salisbury will assume the presidency and deliver an address. On Thursday, August 9, a soirée will be held. On August 10, a discourse will be delivered by Dr. W. H. White, C.B., F.R.S., on "Steam Navigation at High Speeds"; on August 13, Prof. J. S. Nicholson will lecture on "Historical Progress and Ideal Socialism"; on August 14 there will be another soirée, and the concluding meeting will be held on Wednesday, August 15.

THE committee for the establishment of a station at Cumbrae, for the study of marine zoology and botany, are making good progress with their arrangements. The *Ark* has now been put into order for the summer months, and the services of an experienced keeper secured. Mr. David Robertson, the well-known "naturalist of Cumbrae," takes a warm interest in the scheme, and is giving it his personal supervision. A number of students have intimated their intention of availing themselves of the facilities for research thus provided. A considerable sum has been subscribed for the erection of a permanent building, and also for the annual expenses of the station—about half of what is required in each case; and the committee have good hopes that the remaining half will soon be obtained.

THE Geologists' Association have arranged an excursion to Oxted and Titsey for Saturday next, under the direction of Mr. G. Leveson Gower and Mr. W. Topley, F.R.S. The district is not only interesting geologically, but contains a number of archaeological remains. During Whitsuntide a long excursion has been arranged to Cambridge and Ely, and on May 26 Mr. John Hopkinson and Mr. Worthington G. Smith will conduct a party to Luton, Caddington, and Dunstable. In the neighbourhood of Caddington are numerous pits in Drift (brick-earth, &c.), and Tertiary remanié beds, worked for clay and sand for brick-making, and for gravel. In these pits Mr. Smith discovered an old Palaeolithic land-surface on Tertiary remanié, surmounted by re-laid Tertiary clay, and contorted, implementiferous red plateau drift. On this Palaeolithic floor flint flakes of all kinds occur in hundreds, nearly all as keen-edged as knives. That these flakes were made on the spot is

shown by the fragments found, which have been struck off, and in many instances have been replaced in their original position, the flint being thus rebuilt. A large Saxon tumulus is also to be seen at Caddington. Close to Zouches Farm is an old pasture, believed to have been a place for making bricks or tiles in mediæval or, perhaps, Roman times; and near Blows Downs is a group of early British hut-foundations. From this it will be seen that the excursion will be one of unusual interest.

Two lectures on "The Æther and its Relations to Material Phenomena" will be delivered at Gresham College, Basinghall Street, on the evenings of May 8 and 9, by Dr. J. Larmor, F.R.S. Prof. Karl Pearson will deliver two final lectures on "The Geometry of Chance," on May 9 and 10.

FOR misleading statements, and the suppression of facts, commend us to the opponents of Pasteur's anti-rabic treatment. If the general public are gulled into believing half of what it sees posted on the public boardings concerning the results of the treatment at the Pasteur Institute in Paris, it must liken the eminent head to a veritable Frankenstein. In our issue of April 19 we noted a few of the facts from the official report contained in the current number of the *Annales de l'Institut Pasteur*. This brought us a letter from Mr. F. E. Pirakis, accompanied by a black-edged document, published by the Victoria Street Society for the Protection of Animals from Vivisection, and headed "M. Pasteur's Double Hecatomb. The Tale of the 257 Dead. (New Edition. Revised to November 20, 1893.)" In our note we recorded that only 72 deaths had occurred amongst the Institute patients since the commencement of the inoculations in 1886. But this fact does not tally with the misrepresentations widely advertised by the anti-vivisectionists; so Mr. Pirakis essays to put us right. In reply to his remarks, we would first point out that the note in question simply gives a summary of the published statistics without any critical commentary thereon. This summary, however, clearly indicates that only those deaths which take place *after* the lapse of *n* days from the date of the last inoculation are included as having occurred *in spite* of the treatment. Our correspondent has apparently not understood this part of the statement, otherwise he would not express surprise at the discrepancy between the 72 deaths given in the statistical report and the 195 deaths which is the total alleged in "M. Pasteur's Double Hecatomb" to have taken place amongst all-comers to the Pasteur Institute. Further, he contrasts the 72 deaths mentioned in the note in *NATURE* with 257 deaths given in the anti-Pasteur circular; but he has apparently not noticed that only 195 of the latter are alleged to have been treated at the Paris Pasteur Institute. A superficial glance at the black-edged document at once shows that many of the deaths there recorded took place *within* fifteen days of the last inoculation, and would, therefore, certainly be excluded from the official statistics of the Pasteur Institute, for the reasons already given. Assuming the total of 195 deaths to be correct, and there are no grounds for impugning the accuracy of the figure, and taking the total number of persons inoculated at the Paris Institute as 14,553—a figure obtained by adding to 14,430, which is the total number of those inoculated at Paris *given* in the official statistics, the number 123, which assuming the correctness of the figures in the anti-Pasteur document represents the number of those patients who were excluded from the official statistics, owing to their death having taken place *within* fifteen days of the last inoculation—it appears that the *total mortality* amongst all the inoculated is only 1·3 per cent. The mortality amongst persons bitten by rabid dogs, and not submitted to treatment, is commonly accepted to be from 15–20 per cent. If the agitators against the establishment of Pasteur Institutes would only look such facts as these in the face, there might be more hope that they would be led to see the error of their ways.

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AFTER the close of the recent Medical Congress at Rome, many of the members took part in various excursions organised for their recreation and instruction. It was during an excursion to the Island of Capri that Prof. Todaro related the following interesting story, which we take from the *Lancet*. Early in this century the riches of the Gulf of Naples for naturalists came to be appreciated by local investigators, and their reports attracted the special notice of Cuvier, from whom the reported riches were communicated, always with fresh increment, through Milne Edwards to Quatrefages. Another and still mightier name to be attracted to the Gulf was Johann von Müller of Berlin, the most encyclopædic of biologists, who, long interested in the inferior vertebrata, had written a classical monograph on them. A contemporary of his, Oronzio Costa of Naples, an investigator of rare powers, had discovered in these waters the *amphioxus*, already known to British and Russian naturalists as the *Branchiostoma lanceolatum*. Costa recognised its true nature, and described it as the first and lowest of the vertebrata. His description at once engrossed von Müller's attention, inasmuch that he had barely read it when he said to his wife, "My dear, you must come with me to the Bay of Naples." Travelling in those days was effected by diligence, and it was not till after some weeks that the great German biologist and his lady reached the bay. Alighting at the Albergo di Roma at Santa Lucia, he sent at once for a mariner to get him a specimen of the *amphioxus*. This man turned out to be Costa's own mariner, Giovanni by name, who forthwith in the grey morning, as the result of a "miraculous draught" under Posillipo, obtained the animal and brought it to von Müller, who was still in bed. Overjoyed with his possession, von Müller put it at once into alcohol, woke his wife, who, tired with the long journey, was sleeping profoundly, and said, "My dear, get up immediately, we are going back to Berlin." Von Müller's enthusiasm was caught up by his compatriot Krohn, who from his sojourn at Messina in 1844 drew his German friends to those waters, till year by year, each spring and autumn, the Teutonic universities sent relays of young naturalists to that seaboard—among them Anton Dohrn—a most accomplished student of nature, to whom we owe the scientific institute founded at Naples and opened in 1873. Since that year the Stazione Zoologica has become more and more the resort of biologists, and now there is hardly a seat of learning in Europe which does not contribute to its maintenance in return for facilities afforded to the student for prosecuting research.

THE Italian Meteorological Office has succeeded, after some difficulty, in establishing a fairly satisfactory thermometrical station on Mount Etna, at an altitude of about 9500 feet, by means of a recording instrument made by Richard, of Paris, which goes for 40 days. By this method 207 days' observations were secured in the year 1893, and direct observations were also made on 72 days. During seven months of the year the mean temperature was below the freezing point. The maximum temperature observed was 60°·8 in September, and the minimum 13°·5 in March. The characteristic of the annual variation is that the low temperatures are prolonged until June, and, in the autumn, the mild temperatures extend up to December.

AN important contribution to the meteorology of South-eastern Europe has been made by the publication of the means of observations for Sophia (Bulgaria) for the years 1891–3, for three hours each day, and for the month and year. During this period the extreme temperatures have varied between –24°·2 in January 1893 and 97°·7 in August 1891. The mean annual rainfall was 31·2 inches, and the greatest daily fall 2·76 inches, in September 1891. The mean annual relative humidity was 74·1 per cent. At the meteorological conference

at Munich, in 1891, the wish was expressed for observations (especially telegraphic reports) from Bulgaria, and the publication of these results by Prof. Watsoff, director of the Central Meteorological Station at Sophia, is a good step in the right direction.

In a letter to the local press, Mr. H. C. Russell, F.R.S., the Director of the Sydney Observatory, recently brought together some facts concerning icebergs and their relation to weather. The letter was written with the view of showing that the icebergs seen near Australia do not influence the weather in the manner commonly supposed. All the reports of icebergs seen within the last two years or so, were collected, and it was found that they numbered eighty-four. In order to locate these icebergs, the position of each ship when ice was seen, was plotted on a map of the world. Of the eighty-four positions thus marked on the map, sixty-one, or 73 per cent., were under the lee of Patagonia, as if they had been carried there by the strong winds and the Cape Horn current, which sets northwards after passing Cape Horn. Round the Cape of Good Hope was another, though less numerous, group of positions, numbering thirteen, and making 90 per cent. of the whole collected in the two localities. About the Crozets two ships reported ice, and two ships reported seeing ice on the same day and in the same longitude at a point 500 miles south-west from Albany. Six other locations were between New Zealand and Cape Horn. Of the eighty-four ships reporting, only two saw ice anywhere near Australia, and that was more than two years ago, on December 14, 1891. As to the effect of icebergs in lowering the temperature, Mr. Russell points out that many observers have reported that the thermometer is not a good indicator of the proximity of ice, no matter whether it is placed in air or in the sea; and this is not surprising if it be remembered that fresh supplies of ocean water and wind are always flowing past the icebergs, and distributing their cold over such wide areas that it becomes inappreciable. Even under the lee of Patagonia, where, in a sense, the ocean is full of icebergs for an area measured by hundreds of miles each way, it does not appear that any very remarkable effect on the temperature is produced, and near Australia, where now and then a few scattered icebergs are seen in the distant offing, no appreciable effect can result from their presence.

At a recent meeting of the Academy of Sciences of St. Petersburg, Dr. S. Wild read an interesting paper on some improvements in the design and construction of magnetic instruments. The paper is divided into four parts, the first containing the results of some experiments which show that metallic wires are preferable to the silk threads usually employed for the suspension of the magnets in magnetographs. The second part deals with the question of the accuracy of the readings given by the instruments employed to record the variations in the magnetic elements, when these instruments are contained in buildings composed of a material (such as ordinary red brick) containing iron. The experiments on this subject, commenced in 1878, have been continued, and show very clearly that a brick building has no influence on the measurements of the strength of the field, while the influence on the dip is quite negligible. The above result has also been deduced theoretically by M. Chwolson by means of the known value of the susceptibility of the bricks. The third part of the paper contains a description of a small magnetometer for determining the value of the horizontal component of the earth's magnetism, designed for the use of travellers in countries where it would be difficult to carry the ordinary instruments. The instrument fits on Hildebrandt's small universal theodolite, which instrument is fitted with a compass. The combined instrument, although of small weight, is capable of giving results of considerable

precision. Thus the dip can be determined to within half a minute of arc, and the horizontal component to within one part in four thousand. Lastly, the paper contains a description of some changes which Dr. Wild has introduced into the portable magnetometer.

In the April number of the *Journal de Physique*, M. H. Abraham gives an account of a method for measuring self and mutual induction, which he says is capable of giving the quantity which is being measured to within one part in a thousand. The method employed consists essentially of balancing a steady current passing through one pair of coils of a differential galvanometer against a succession of induced currents sent, by means of a commutator rotating at a known speed, through the other coils. The commutator then being stopped, the secondary circuit, containing one pair of coils of the galvanometer, is connected with the extremities of a resistance r in the primary circuit. The value of r is altered till the galvanometer is undeflected, then, from a knowledge of the value of r and the speed of rotation of the commutator, the value of the mutual induction can be calculated. In many ways the method resembles that employed by Profs. Ayrton and Perry in their secchi-meter.

THE line spectrum of oxygen has recently found another careful investigator in Max Eisig, who gives an account of his work in *Wiedemann's Annalen*. The wave-lengths photographed and measured ranged from $2433\cdot6$ to $4710\cdot4$. The oxygen was generated by the electrolysis of water acidulated with pure phosphoric acid. The form of vacuum tube adopted was that consisting of two vessels joined by a thin tube at right angles to their length, which allowed the gas to be seen through the length of the tube. The end was closed by a plate of quartz to permit the passage of the ultra-violet rays. The tube was cleaned by flushing it with oxygen for several weeks. Of the four different oxygen spectra described by Schuster, only the elementary line spectrum was studied; 93 lines were recorded and measured. A comparison of these lines with a Rowland solar spectrum led to the conclusion that no identity between these oxygen lines and lines in the solar spectrum can be established.

PROF. JULIUS THOMSEN, universally known from his researches in thermo-chemistry, has just finished a series of observations on the ratio of the atomic weights of hydrogen and oxygen (*Zeit. für phys. Chem.* xiii. 398). In order to avoid the errors incidental to the direct methods of estimating the ratio, he employs an indirect method, which consists in estimating the ratio of the molecular weights of hydrogen chloride and ammonia. Pure hydrogen chloride is passed into a flask containing water, and the increase in weight is determined. Pure dry ammonia is then introduced into the solution until the hydrochloric acid is neutralised, and the weight again determined. After introducing all corrections, a large number of observations, in which the initial amount of hydrogen chloride varied between 4 and 20 gr. indicate that the value for the ratio, HCl/NH_3 is $2\cdot13934 \pm 0\cdot00009$. This number leads to the result that 1 : 16 represents the value of the ratio H : O with an accuracy as great as is warranted by the numbers in use for the atomic weights of chlorine and nitrogen, and which have of course to be employed in the calculation. Dumas and Erdmann and Marchand, from the synthesis of water from copper oxide and hydrogen, found respectively $1\cdot0025 : 16$ and $1\cdot0017 : 16$ as values of the ratio, and more recently Scott, from the volume composition of water, gives the higher value $1\cdot0087 : 16$.

In a recent number of the *Centralblatt für Allgem. Pathologie* some exceedingly interesting experiments are recorded on immunity from the attacks of cholera germs artificially induced in the human subject. Drs. Sawtschenko and Sobolotny suc-

ceeded in preparing a vaccine from cultures of the cholera bacillus which so profoundly modified the system, that when they subsequently swallowed virulent cholera germs they experienced absolutely no evil effects whatever. But perhaps the most interesting results obtained, and which proved in a very remarkable manner the modification induced in the system by this vaccine, was the transmission of this induced immunity by means of blood serum to animals. Thus, twenty-five days after the last dose of vaccine had been taken, Sawtschenko and Sobolotny introduced some of their serum into guinea-pigs, and the latter were afterwards inoculated with virulent cholera bacilli. Instead, however, of these animals dying, as they usually do when treated with cholera bacilli, they remained alive. It was found that 0.01 g. of this human serum was sufficient to protect one of these animals subsequently treated with 0.006 g. of virulent cholera bacilli.

AN inquiry into the pollution of the River Danube by the drainage from Vienna was carried out last year by Dr. Heider (*Das Österr.-Sanitätswesen*, 1893, No. 31). This river reaches Vienna in a satisfactory condition, containing about 2000 bacteria per cubic centimetre. The Danube canal on its way through the city receives the greater part of its sewage, resulting, as was to be expected, in an enormous accession of bacteria, 21,000—120,000 per c.c. being present. On uniting with the main-stream and becoming mixed with about seven times the volume of water, the pollution is chemically hardly discoverable. Bacteriologically, however, even 40 kilometres below the entrance of the canal, the contamination is still very easily perceptible, the rapidity of the current and the constant disturbance of the water by steam-boat traffic interfering with the efficient sedimentation of the bacteria present. Dr. Heider states that though the existence of disease germs in the water may be interfered with by the severe competition they would have to endure with the numerous harmless microbes, yet the vitality of, for example, cholera bacilli in river water has been shown to persist for several days, and in sewage for very considerable periods of time, so that too much reliance cannot be placed upon the efficiency of this factor. The action of light in destroying disease germs in the river, should they be present, is also discounted. Those who so ardently uphold the comfortable doctrine of the self-purification of rivers, permitting, as it does, of so inexpensive and ready a method of getting rid of sewage by turning it, without let or hindrance, into our streams, will gain but little support for their theories from Dr. Heider's report.

IN the April number of the *Journal of Anatomy and Physiology*, Prof. R. Havelock Charles concludes an article on morphological peculiarities in natives of the Panjab, and their bearing on the question of the transmission of acquired characters. He shows that the bones of the lower extremity of the Panjabi adult have certain markings differentiating them from those of Europeans. Though these markings are found on the bones of the foetus, the infant, and the child of the Panjabi, they are not found in the skeleton of either the European adult or child. Some of them have been found in the remains of peoples of the present day of similar geographical distribution. According to Prof. Charles, the explanation of this lies in the fact that the habits as to sitting postures of Europeans differ from those of their prehistoric ancestors, the cave-dwellers, &c., who probably squatted on the ground. The Orientals, however, have retained the sitting postures of their ancestors, and therefore exhibit similar markings. "Want of use," concludes Prof. Charles, "would induce changes in form and size, and so gradually small differences would be integrated till there would be total disappearance of the markings on the European

skeleton, as no advantage would accrue to him from the possession of facets on his bones fitting them for postures not practised by him. The facets seen on the bones of the Panjabi infant or foetus have been transmitted to it by the accumulation of peculiarities gained by habit in the evolution of its racial type—in which an acquisition having become a permanent possession 'profitable to the individual under its conditions of life' is transmitted as a useful inheritance. These markings are due to the influence of certain positions, which are brought about by the use of groups of muscles, and they are the definite results produced by actions of these muscles. . . . They are instances of the transmission of acquired character, which heritage in the individual function subsequently develops."

THERE are many evidences that a portion of the east coast of Florida was thickly populated in prehistoric times, and remains of this settlement are found in refuse heaps of villages and single habitations. These heaps are from a few square yards to many acres in extent, and from one to fifteen feet in depth. Some of their contents are described and figured by Dr. De Witt Webb, in an excerpt from the *Proceedings of the U.S. National Museum* (vol. xvi. No. 966). In connection with the remains, various members of the human skeleton have been found in positions which suggest cannibalism. There are hearths with accumulations of ashes and shells mingled with pottery (mostly in fragments) and implements and weapons of shell, all of which tell something of the mode of life of the race which apparently inhabited the region for many generations. As to the age of the heaps, Dr. Webb concludes it must be left to conjecture. Trees hundreds of years old are scattered over the remains, all instruments and implements of wood have long since perished, and not even a tradition is left to throw light upon the matter.

A SECOND edition of "A Manual of Ethics" designed for the use of students, by Mr. John S. Mackenzie, has been published by the University Correspondence College Press.

MESSRS. CASSELL AND CO. have commenced a new serial issue, in monthly parts, of Mr. W. Swaysland's "Familiar Wild Birds." In Part i. the Goldfinch and the Magpie are described and pictured. The descriptions, though brief, are very instructive, and the plates are extremely good.

IN addition to the usual excellent summary of current researches, the *Journal of the Royal Microscopical Society* for April contains the fifth part of Mr. F. Chapman's paper on the foraminifera of the gault of Folkestone; a description of an inexpensive screen for monochromatic light, by Mr. J. W. Gifford; and an account of a gall-producing Copepod, *Fucitrogus Rhodymia*, sp. n., by Dr. G. S. Brady, F.R.S.

THE long-expected work on the Carboniferous Insects of Commeny, France, upon which M. Charles Brongniart, of the Paris Natural History Museum, has been engaged some fifteen years, is now finished, and will appear in a few weeks. It forms a volume of 450 pages in quarto and an atlas of thirty-seven plates in folio. About 60 new genera and 100 new species are described. The work also contains a detailed study of the nervation of living *Neuroptera*, *Orthoptera*, and *Fulgoroidea*.

A PAMPHLET, entitled "Notes on Birds of Central Mexico, with Descriptions of Forms believed to be New," by Mr. F. L. Jouy, has been issued as an excerpt from the *Proceedings of the U.S. National Museum* (vol. xvi. pp. 771-791). Most of the species enumerated are from the temperate table-land region corresponding to the southern borders of Arizona and New Mexico, and though few common tropical birds are given, the list will certainly be found valuable.

A *propos* of the early return of birds this year, Mr. J. H. Barbour, writing from Ballyholme, Ireland, says that on Saturday, April 28, about 10 p.m., he heard the corn-crake several times, and it was heard in the district a fortnight before.

A LETTER has been received in reply to the one on "The Mass of the Earth," which appeared in our issue of April 19 (p. 575), but it was not accompanied by the author's name. If the author will send his name, the Editor will be glad to print his reply to "K."

DR. JENTINK, the Director of the Leyden Museum, reminds us that two specimens of *Rhinoceros simus* have formed part of the Museum collection for more than forty years, one of them being a remarkably fine animal. These are described in *Notes from the Leyden Museum* (1890, pp. 241-245), and we regret that they were not mentioned in the note on the two specimens recently modelled by Mr. Rowland Ward, printed in *NATURE* of April 19 (p. 584).

WE know of no collection of text-books in which the theory underlying industrial machines and processes is set forth in a more scientific and thorough manner than it is in the works of the *Encyclopédie Scientifique des Aide-Mémoire* series, edited by M. Léauté, and published by Gauthier Villars, and by Masson. Two of these volumes, which have recently appeared, deal with freezing machines, one being devoted to the machines depending upon easily liquefiable gases, and the other to machines in which air, or one of the so-called permanent gases, is caused to expand rapidly, and thus bring about a decrease of temperature. The titles of the two books are, respectively, "Machines Frigorifiques a Gaz Liquefiables" and "Machines Frigorifiques a Air," and their author is M. R. E. de Marchena. Another volume, just added to the series, is "Construction and Resistance des Machines a Vapeur," by M. Altheilig.

WE have received the sixteenth yearly volume of *Aus dem Archiv der Deutschen Seewarte*, 1893, containing seven important discussions in meteorology and terrestrial magnetism. The current number of this valuable publication inaugurates a new departure, as a considerable amount of routine matter has been removed to another periodical, in order to make room for scientific discussions, and to allow of the work being brought out with less delay than heretofore. It is not practicable to mention here the whole of the subjects dealt with: among the most original investigations not already referred to in our columns are papers by Dr. C. Kassner on "Circular Cyclones," and by Dr. W. Köppen and Dr. H. Meyer, on the frequency of the various amounts of cloud as a climatological element. This last paper embraces the results of a number of long series of cloud observations in different parts of the globe, and a part of the North Atlantic Ocean.

IN general, a work which has reached a seventh edition needs no better testimony of its good qualities than that to be found in the fact of its survival. This is the case with Sir David Salomon's "Electric Light Installations and the Management of Accumulators," which is being issued by Messrs. Whittaker and Co. The edition has been mostly rewritten, and will be completed in three volumes. The first volume appeared a short time ago, and was confined entirely to the treatment of accumulators. Vol. ii., which has just been issued, deals with engines, dynamos and motors, and numberless pieces of apparatus concerned in the generation and utilisation of electricity. Special applications of such apparatus are reserved for description in vol. iii., now in the press. In the three hundred pages of which the second volume consists, as many as 296 illustrations are crowded; but as the author has confined himself to the representation of typical forms of instruments, he has saved the book from being merely an illustrated trade catalogue.

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THE Cambridge University Press will shortly publish a treatise on the "Steam Engine and other Heat Engines," by Prof. Ewing; the seventh volume of the edition of Prof. Cayley's collected papers, and the first volume of the collected papers of the late Prof. Adams. An "Elementary Treatise on Electricity and Magnetism," by Prof. J. J. Thomson, is in the press, and also a new edition of Prof. Lamb's "Hydrodynamics," largely rewritten and extended. An "Elementary Treatise on Hydrostatics," by Mr. John Greaves, has just appeared, and a Key to Mr. C. Smith's "Arithmetic" is nearly ready. The completion of Mr. H. M. Taylor's "Euclid" is also announced, and will be published in August. The second volume of Dr. Creighton's "History of Epidemics" may be expected shortly, and a new volume of the Royal Society's Catalogue. In the series of Cambridge Natural Science Manuals, Mr. Glazebrook's volumes on "Light" and "Heat," recently published, will be followed by volumes by the same writer on "Mechanics and Hydrostatics," and on "Electricity and Magnetism," and by Messrs. Darwin and Acton's "Physiology of Plants."

DR. J. P. VAN DER STOK, the Director of the Batavia Meteorological Observatory, has sent us a report of the rainfall observations made in the East Indian Archipelago during 1892. This "Regenwaarnemingen in Nederlandsch-Indie" has now reached its sixteenth year. From it we learn that observations were made in 192 stations during 1892, of which 104 were in Java and Madura, and 88 in Sumatra and other islands in the Archipelago. In addition to the volume of rainfall observations, the Government of Netherlands India has published one containing the observations made at the magnetic and meteorological observatory at Batavia during 1892, being the fifteenth volume of the "Observations" of the Observatory. No science can claim so many disciples as meteorology. There is scarcely a corner of the world, inhabited by civilised man, in which the temperature is not recorded and the rainfall measured. Indeed, the thermometer and the rain-gauge are the instruments by means of which the first continuous scientific observations are made in most parts of our globe. Meteorological observations, therefore, rapidly accumulate, and the volumes containing them have almost become unmanageable, both as regards number and size. One is sometimes tempted to ask whether these masses of statistics are worth publication, but the remembrance of past discoveries—such, for instance, as Schwabe's discovery of the solar cycle from his daily records of the state of the sun's surface during a quarter of a century—shows the importance of recording all observations that good may come from them.

A FURTHER paper by M. Lobry de Bruyn, of Amsterdam, upon the subject of free hydroxylamine, is contributed to the current issue of the *Berichte*. It contains an account of a number of experiments upon the stability of the isolated base, together with additional observations upon the mode of preparation. When M. de Bruyn prepared his large quantity of solid hydroxylamine three years ago, several small quantities, amounting to five or six grams in each case, were sealed up in small bottles previously cleansed with acid, and preserved in a dark room. Upon recently examining the contents, they were found to be mostly liquid, indicating a certain amount of decomposition. The melting point of pure hydroxylamine is 33°; two of the liquefied specimens referred to solidified again at 28°·5 and 25°·2 respectively. The amount of decomposition, however, is not very great, three of the specimens being found to contain 93, 84, and 73 per cent. respectively. Hence free hydroxylamine appears to be a tolerably stable substance at ordinary low temperatures, but the stability diminishes rapidly with rise of temperature. The decomposition is accompanied by the liberation of bubbles of nitrogen and nitrous oxide. The change appears to be one of self-oxidation and reduction, one

portion eliminating oxygen and forming ammonia, and another part suffering oxidation to nitrous and hyponitrous acids, which combine or react with the ammonia and a further quantity of hydroxylamine. As hydroxylamine nitrite spontaneously decomposes, as M. de Bruyn has shown by experiment, it is probable that the hyponitrite of the base is incapable of existence; hence the liberation of nitrogen and nitrous oxide is fully accounted for. M. de Bruyn states that in preparing large quantities of the solid base by fractional distillation of the methyl alcohol solution under diminished pressure it is preferable, after distilling off the methyl alcohol, to divide the residue rich in hydroxylamine among several distilling flasks, and to thus complete the fractionation in small portions. For it is a somewhat remarkable fact that the yield is very much larger when the distillation occurs in this manner; it would appear that the amount of decomposition considerably increases with the bulk of liquid distilled. Moreover, the risk of explosion upon temporarily arresting the distillation in order to change the receiver, is greater with larger quantities, but usually an explosion may be prevented by immersing the distilling flask in cold water during the rapid change of receivers. Taking this precaution, M. de Bruyn has safely distilled as much as half a kilogram of the pure base.

ERRATUM.—In NATURE of April 26 (p. 603), and on the tenth line from the bottom of the first column, for "mosses" substitute "mirses."

THE additions to the Zoological Society's Gardens during the past week include two Macaque Monkeys (*Macacus cynomolgus*) from India, presented respectively by Mr. C. Palmer and Miss A. Orvis; two — Jackals (*Canis variegatus*), two Fennec Foxes (*Canis cerdo*), two Pale Fennec Foxes (*Canis pallidus*), a Syrian Fennec Fox (*Canis famelicus*), an Egyptian Cat (*Felis chaus*), a — Genet (*Genetta*, sp. inc.), a — Zorilla (*Ictonyx frenata*), a Crested Porcupine (*Hystrix cristata*), two — Gerbilles (*Gerbillus*, sp. inc.), two Lesser Egyptian Gerbilles (*Gerbillus aegyptius*), three Spiny Mice (*Acomys*, sp. inc.), six — Uromastix (*Uromastix ornatus*) from Suakin, a Libyan Zorilla (*Ictonyx lybica*), two Dwarf Jerboas (*Dipodillus*, sp. inc.), four Spiny Mice (*Acomys*, sp. inc.), three — Hedgehogs (*Erinaceus auritus*), two Egyptian Jerboas (*Dipus aegyptius*) from Egypt, presented by Dr. John Anderson, F.R.S.; a Wattled Crane (*Grus carunculata*), two Cape Crowned Cranes (*Balearica chrysopelargus*) from South Africa, presented by Sir H. B. Loch, G.C.B., G.C.M.G.; a Grey Ichneumon (*Herpestes grisens*) from India, presented by Mr. John Penn, M.P.; two Robben Island Snakes (*Coronella phocaenum*) from South Africa, presented by Mr. Barry McMillan; an Indian Civet (*Viverricula malaccensis*) from India, a long-Legged Buzzard (*Buteo ferax*) captured in the Red Sea, a Mexican Deer (*Cariacus mexicanus*) from Mexico, deposited; four Red-headed Pochards (*Fuligula ferina*), European, purchased.

OUR ASTRONOMICAL COLUMN.

AN ASTRONOMICAL EXPEDITION FROM HARVARD.—A party, in charge of Prof. W. H. Pickering, will soon set out from Harvard College Observatory (says *Astronomy and Astro-Physics*) to establish an observing station somewhere in the State of Arizona, the principal object of the expedition being to observe Mars during the favourable opposition this year. The chief instrument to be conveyed to the site chosen is an eighteen-inch refractor by Brashear, the objective of which was exhibited at the Chicago Exposition. Mr. Percival Lowell, of Boston, who has generously provided the funds for the expedition, will accompany it as an observer.

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ELEMENTS AND EPHEMERIS OF GALE'S COMET.—*Edinburgh Circular*, No. 42, contains the subjoined ephemeris for Gale's comet, computed by Mr. A. J. Ramsay.

Ephemeris for Greenwich Midnight.

1894.	R.A.	Decl.	Bright- ness.
	h. m. s.	° ' "	
May 3	8 17 17	7 20' 6"	
4	8 28 4	S. 3 26' 6"	5'42
5	8 38 18	N. 0 16' 6"	
6	8 48 1	3 47' 4"	
7	8 57 10	7 37	
8	9 5 49	10 5' 7"	3'97
9	9 13 59	12 52' 7"	
10	9 21 42	15 25' 6"	
11	9 28 57	17 45' 4"	
12	9 35 52	19 52' 7"	2'70
13	9 42 22	21 48' 2"	
14	9 48 28	23 33' 3"	
15	9 54 16	N. 25 10' 7"	2'00

The brightness at the time of discovery has been taken as unity.

THE HATCHERY FOR SEA FISHES, OF THE FISHERY BOARD FOR SCOTLAND AT DUNBAR.

IN recent years, owing to over-fishing, the scarcity of certain important marine food-fishes has become manifest in many countries, and as one way of meeting the constant drain on the fishing grounds, sea-fish hatcheries have been established in the United States, Newfoundland, Canada, and Norway. A year or two ago the Fishery Board for Scotland began the erection of a similar establishment at Dunbar, which has lately been completed; and for the last five or six weeks active operations have been going on in hatching plaice, with complete success, under the charge of Mr. Harald Dannevig, a Norwegian expert, whose services have been obtained by the Fishery Board. The hatchery consists of (1) a tidal pond; (2) a large "spawning" tank; (3) a chamber for the collection of the eggs and for filtering the water; and (4) the house in which the hatching apparatus is placed. The spawning fishes, male and female, number about 350, and are confined in the large elevated spawning tank (made of concrete) through which a constant current of sea water is maintained. They range from about 14 to 27 inches in length, and are vigorous and feed well. In this tank, which has a capacity of over 60,000 gallons, the fishes spawn naturally, just as they would in the sea; and as the eggs are buoyant they rise to the surface, or near it, and are collected in hundreds of thousands at a time in a specially constructed apparatus placed at the point where the overflow from the tank occurs. The fertilised eggs, which are among the largest of the pelagic forms, are then transferred to the apparatus in the hatching room, through which a continuous circulation of pure sea water is kept up. The hatching takes nearly three weeks to accomplish, and the little fishes are retained for some time after hatching until the yolk is almost absorbed. In smaller vessels with a higher temperature, hatching occurs more rapidly, but the period named (three weeks), probably approaches the normal period in the sea. The number of plaice eggs and larvae at present in the hatching boxes is 8,500,000, and over 7,700,000 fry have been already put in the Firth of Forth by the s.s. *Garland*. The supply of sea water required is considerable, and is obtained by means of two double-acting steam pumps, capable of throwing over 7000 gallons an hour, and driven by an 8 h.p. locomotive boiler. Before being conducted to the hatching apparatus, the water passes through a series of flannel filters, but from its purity when it comes from the sea the filtration gives little trouble. Strong evidence of the suitability of the water for the purpose, and of the satisfactory working of the arrangements, is afforded by the very low death-rate, that is to say, the proportion of eggs which succumb in the process of hatching. At Dunbar it has not exceeded 4 per cent.—a much lower death-rate, so far as known, than at any other marine hatchery. At the Newfoundland hatchery the death-rate has varied from about 37 per cent. to nearly 50 per cent. in different years;

and at the Norwegian hatchery the rate has been even higher. At these establishments, however, the ova of the cod have alone been dealt with, and they are somewhat more delicate than those of the plaice. Nevertheless, check observations with 500,000 cod eggs at Dunbar show a death-rate under 4 per cent. The density of the water has remained practically constant at a little over 1027; the temperature, which at the beginning of March was 4°·5 C., has gradually risen to 6°·3 C., and the hatching process is becoming accelerated.

So far as can be judged at this period, it is probable that the "turn-out" of young plaice during the present season will exceed 30,000,000—a much larger number than has been turned out in the first year at any other sea-fish hatchery. In Norway the first year's issue was 5,095,000 cod (it is now over 200,000,000), and at the Newfoundland establishment it was 17,000,000 cod. This is the first occasion in which plaice, or indeed any flat-fish, have been hatched on a large scale. It was anticipated that there might be difficulties in getting the fishes to spawn under the somewhat unnatural conditions; but none occurred. It is expected that, in the course of the summer, when the spawning period of the plaice is over, that somewhat valuable fish, the common sole—which is rare in Scottish waters—will be dealt with, as well as the lemon sole, and possibly the turbot. All these fish are becoming scarcer and dearer.

The present plant at the Dunbar hatchery—viz., the spawning pond, filtering apparatus, boiler, pumps, &c.—is adapted for a hatching house about three times as large as the present one. When the latter is extended, and the hatching apparatus increased, there will be no difficulty in turning out many hundreds of millions of the fry of the food-fishes every year. The actual hatching—and in many cases the rearing—of almost all the food fishes, has been accomplished for scientific purposes by Prof. McIntosh at the neighbouring laboratory at St. Andrews, and the experience thus gained will be of the greatest utility in carrying on the work from the commercial point of view. It is anticipated that large rearing ponds will be added, to enable the young flat-fish to be kept until they assume the habits of the adult, and thus greatly increase the usefulness of the establishment to the fishery industry.

T. WEMYSS FULTON.

THE FORTHCOMING CONGRESS OF HYGIENE AND DEMOGRAPHY.

FROM a circular just received, we learn that satisfactory progress has been made with the arrangements for the eighth International Congress of Hygiene and Demography, to be held at Budapest, from September 1 to 9. The work of the Congress will be carried out in two divisions, relating respectively to hygiene and demography. Hygiene comprises nineteen, and demography seven, sections. In Section I. of the former division (the etiology of infectious diseases, or bacteriology), notices of thirty papers had been received up to March 31; in Section II. (the prophylaxis of epidemics), thirty-six papers are at present announced; in Section III. (the hygiene of the Tropics), twelve papers; in Section IV. (the hygiene of trades and agriculture), twenty-nine papers; in Section V. (the hygiene of children), twenty-eight papers; in Section VI. (the hygiene of schools), thirty-nine papers. Thirty-six papers have been notified in Section VII. (articles of food); thirty-eight in Section VIII. (the hygiene of towns); eleven in Section IX. (the hygiene of public buildings); nine in Section X. (the hygiene of dwellings); seventeen in Section XI. (the hygiene of communications, that is, of railroads and navigation), and twenty-four in Section XII. (military hygiene). Fourteen papers are promised on the saving of life (Section XIII.), thirty-three on State hygiene (Section XIV.), six on the hygiene of sport (Section XV.), twenty on the hygiene of baths (Section XVI.), thirty-eight on veterinary matters (Section XVII.), seventeen on pharmacology (Section XVIII.), and eleven on general sanitarian affairs (Section XIX.).

The demographic sections of the Congress are (1) historical demography; (2) general demography and anthropometry; (3) the technicalities of demography; (4) the demography of the agricultural classes; (5) the industrial workmen from a demographic point of view; (6) the demography of towns; (7) the statistics of bodily and mental defects. Papers for each of these sections have been received or promised. Up to the end of

March the total number of papers announced was 535, of which 437 belong to the hygiene division, and 98 to demography. There seems every probability that the Congress will be a worthy success or to former ones as regards the scientific value of the work, and its international character is vouched for by the fact that nearly 250 official delegates have been nominated.

In accordance with a resolution passed at the Congress of Hygiene and Demography held in London in 1891, an international committee has been formed to prepare for discussion questions relating to the cause and prevention of diphtheria. This committee contains the representatives of fifteen different nationalities, as follows:—Austria, Prof. Wiederhofer; Bavaria, Prof. Henry Ronde; Belgium, Dr. E. Tordeus; England, Dr. Edward Seaton; France, Dr. F. Roux; Germany, Prof. Frederic Löffler; Hungary, Dr. Cornelius Chyzer; Italy, Prof. Luigi Pagliani; Norway, Prof. Axel Johanessen; Roumania, Prof. Măldărescu; Russia, Prof. Nicolas Filator; Spain, Prof. Francisco Criado y Aquilar; Sweden, Prof. E. Almquist; Switzerland, Prof. Haganbach-Burkhardt; United States of America, Prof. S. Billings.

An exhibition will be held in connection with the Congress, but only of objects which serve to elucidate and exemplify questions brought up for discussion, and those which mark real progress in sanitary matters and public health. This is done in order to prevent the exhibition from becoming a vehicle for trade advertisement. No awards will be made, but objects of special importance will be named in the minutes of the closing meeting. No charge will be made for space, and objects sent in are duty free. Intending exhibitors must give notice before May 15 to the General Secretary, Prof. Dr. Coloman Müller, St. Rochus Hospital, Budapest, who will supply the proper application forms.

Membership of the Congress can be obtained by transmitting the amount of £1 (for ladies the sum is 10s.) to Prof. Müller. This fee entitles the sender to admission to all the meetings, excursions, and various social gatherings arranged, to a copy of the Proceedings of the Congress, and to railway journeys at reduced rates.

The Corporation of Budapest will hold a reception in the halls of the Town-Redoute, and a garden party in the grounds of the National Museum. All the learned societies and bodies interested in the work of the Congress have also made arrangements for receptions. At the Royal Opera House, the National Theatre, and the People's Theatre, special representations will be given in honour of the meeting; in fact, there is every reason for believing that members will come away with a favourable impression of Hungarian hospitality. As to the more serious side of the meeting, the list of papers down to be read shows that there will be no dearth of subjects for discussion. A number of important questions will therefore be ventilated, and even if many of them fail to elicit a definite opinion, a clearing of ideas is bound to result from their discussion.

SEWER GAS AND TYPHOID FEVER.

IT is now more than thirty years ago since two eminent physicians discussed, with some heat, in the columns of the medical papers and elsewhere their theories on the origin and distribution of typhoid fever. While Dr. Murchison and his party regarded the exhalations from drains as the *specific cause* of typhoid, Dr. Budd and his supporters argued that the gases from putrid liquids were only capable of producing this disease in the presence of some particular contagion. The discussion was taken up on the continent, and the sewer-gas theory was vigorously fought over, but towards 1880 the whole subject was revived, and its supporters were later confronted with the results of bacteriological investigations on sewer-air, which showed that there were not more organisms present in drains than in the outside air, and that under normal conditions, currents of air were unable to detach disease microbes, should they be present, from the effete materials present in the sewer.

Meanwhile English hygienic authorities, without waiting for the scientists to make up their minds on this crucial question, preferred to act, at any rate, on the assumption, supported as it was by much experience and many facts, that the exhalations from drains were undesirable and dangerous in our houses and surroundings, and should be rigorously excluded. The advance in sanitation, and its splendid results during the past ten years or so, is a sufficient testimony to the wisdom of the

agitation which determined the crusade against bad drainage and unsanitary appliances in this country.

But the inquiring spirit of the scientist, which abhors blind empiricism, and seeks always to reach the root of the matter, has again been exercising itself on the question of the spread of disease by sewer-gas, and it is significant that in the most recent report to hand on sewer-air, the direct connection of the latter with the distribution of zymotic disease is declared to be still wrapped in mystery and uncertainty, and we find our precise and scientific information on this subject as meagre as it was some thirty years ago. All the more important and welcome, therefore, are some very original investigations which have just been published by Dr. Alessi, who has not contented himself with finding very few and harmless microbes in sewer-air, but has submitted the whole question of its relation to typhoid fever to a searching experimental inquiry.

For this purpose the effect of inhaling sewer-air and the gases from putrifying materials was examined on animals—rats, rabbits, and guinea-pigs being selected. After exposure to sewer-air, which was accomplished by placing them in a box with a perforated bottom communicating directly with a drain, they were inoculated with a small quantity of only a slightly virulent cultivation of the typhoid bacillus, whilst other animals were similarly treated, except that they were not compelled to inhale these noxious gases, but were kept in their ordinary surroundings. The rats, after inhaling this foul air, began to lose their vivacity, and after a time grew thin, although they eat voraciously, and out of forty-nine which were inoculated with typhoid germs thirty-seven died exhibiting the typical symptoms of typhoid infection. Of those forty-one rats, however, which, although infected with typhoid, had not inhaled sewer-air, only three succumbed. Thus the inspiration of drain-air had so far predisposed these animals to infection from typhoid that a small dose of an almost harmless growth of this organism proved very fatal to them. Guinea-pigs and rabbits exposed in like manner to gases from materials in a condition of active decomposition also acquired a predisposition to typhoid infection, for out of seventy-two guinea pigs inoculated, fifty-seven died, whilst not one of those treated with typhoid germs in ordinary surroundings succumbed. Every one of the eleven rabbits similarly treated died, but not one of the inoculated animals kept in ordinary surroundings. Dr. Alessi also found that the inhalation of these gases from putrid substances enabled a small dose of a weakened culture of the *B. coli communis*, normally present in the intestine, to produce fatal results when purposely introduced into the animals thus exposed.

It was also ascertained that it was during the first two weeks of exposure to these noxious gases that the animals were most easily predisposed to typhoid infection, for no less than ninety per cent. of all the animals inoculated during the first fortnight died, whilst seventy-six per cent. succumbed of those inoculated in the third week. This fact may, says Dr. Alessi, partly explain how it is that some people who habitually breathe contaminated air do not appear to suffer any evil results, having gradually in course of time become accustomed to it, whilst a stranger exposed to the same conditions without previous experience may suffer very severely. The degree of predisposition, however, whilst varying in different animals, would also vary in different people.

These investigations must be regarded as a noteworthy and an important contribution to our knowledge of the distribution of disease, affording as they do so remarkable an experimental confirmation of the wisdom of a policy of sanitation dictated by instinct and intuition.

ANOTHER NEW BRANCHIATE OLIGOCHÆTE.

ABOUT two years since I described in the columns of this journal (vol. xlv. p. 109) an Annelid belonging to the family Tubificidae, which was unique in that family in the possession of a series of branchial processes upon the posterior segments of the body. This worm, as I reminded the readers of NATURE on Jan. 11 (vol. xlix. p. 247) was found in the "Victoria Regia tank" at the Botanical Society's Gardens—a locality which has produced many interesting invertebrate animals. I have now to record the existence of another Oligochaetous Annelid in which branchial processes of a very similar nature to those of *Branchiura Sowerbii* are found. This worm was sent

to me by Dr. Michaelsen, of Hamburg, a well-known authority upon this group of animals; it had been collected by him in South America during a recent expedition for collecting purposes to that country. With great generosity he has handed over to me for study the bulk of the Oligochaeta which were brought home by him from Patagonia, the Argentine, and Chili; and the species upon which I desire to say a few words here was among those worms. It was discovered in the river at Valdivia, in Chili. The worm, like *Branchiura*, is a member of the family Tubificidae, but it clearly represents a new genus of that family, into the general characters of which I do not propose to enter here. The collection contains several species of this new genus, for which I suggest the name of *Hesperodrilus*. The gilled species is not unlike the common *Tubifex* of our streams and lakes in outward appearance, but it differs from *Tubifex* and agrees with *Branchiura* in having a series of branchial processes attached to some of the posterior segments of the body; as I have only examined one specimen, it is impossible to say whether the limited number of these gills, in comparison with those of *Branchiura*, is a distinguishing mark; but, in any case, they differ by reason of the fact that they are lateral in position, being attached to the body just below the lateral setæ; in *Branchiura* it will be remembered that they are dorsal and ventral in position (cf. *Quart. Journ. Micr. Sci.* March, 1892, for the more complete description of *Branchiura*). It is well known that the Tubificids, as a rule, live imbedded in the mud with the tail—and not the head—end extruded, and generally waving about in the water; it is thus intelligible how the development of gills upon the posterior, rather than the anterior, end has come about. The single specimen which I have examined possessed about thirteen pairs of branchiæ; these were at first very small, but gradually increased in size towards the end of the body, those upon the terminal segments being, if anything, larger than those upon any of the preceding segments; in *Branchiura* the gills diminish in length towards the extremity; it may be that my specimen of *Hesperodrilus branchiatus* had recently lost the tail, but there were no obvious signs of this. The genus differs from *Branchiura*—and, indeed, from any other genus of Tubificidae known, unless my *Hesperodrilus* be accounted a Tubificid—in that the spermathecae (which are unusually long) open behind the male pores, instead of, as in the other Tubificids, in front of them. I mention this point to show that I have not confounded this new gilled Tubificid with *Branchiura*.

FRANK E. BEDDARD.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—In a congregation held on April 26, Prof. A. H. Green and Prof. C. Lapworth were appointed Examiners in the Final School of Natural Science (Geology), and Prof. H. Marshall Ward and Prof. F. W. Oliver were appointed Examiners in the same school in Botany. All the appointments were made for one examination only.

Notice is given that the final examination for the degree of Bachelor of Medicine will begin on Monday, June 4. Names to be sent in by May 19. The examination for the degree of Master of Surgery will begin on Wednesday, June 13. Names to be sent in by May 30. The first examination for the degree of Bachelor of Medicine will begin on Friday, June 22. Names to be sent in by June 7.

The degree of D.C.L. *honoris causa*, was conferred on Wednesday on Prof. August Weissmann.

At a meeting of the Board of Faculty of Natural Science on Tuesday last, new regulations for the preliminary examinations in Animal Morphology and Animal Physiology were approved of. The new regulations will come into force in Michaelmas Term, 1894.

At a meeting of the council of University College, Liverpool, held on Tuesday, it was announced that Lord Derby had telegraphed his intention to provide for the endowment of the chair of Anatomy. It was resolved that Lord Derby be requested to allow his name to be permanently associated with the chair. Formal intimation was also given of the endowment of a chair of Pathology by Mr. George Holt with £10,000. It was decided that the new chair should be called the George Holt Chair of Pathology, and that candidates for the chair should be invited

to send in their names. Another announcement made was that Mr. Henry Tate would present to the Tate Library a collection of standard books of the value of £5,500. The endowment of the chairs of Anatomy and Pathology completes the provision necessary in order to bring the medical department of the College into rank with similar departments at the older Universities and at Owens College, Manchester.

The arrangements for the University Extension Congress, to be held in London in June next, have been announced. There are several reasons which render the present year opportune for such a gathering. In the first place, the University Extension movement attains its majority, the first Courses of Lectures having been arranged by the University of Cambridge in the autumn of 1873. And secondly, University Extension work has a defined place in the scheme for the establishment of a Teaching University for London. In view of the anticipated establishment of a Teaching University on the lines laid down in the Report of the Royal Commission, it is important to sum up and present the educational results of the twenty-one years' work in University Extension, and to consider, in the light of past experience, practical proposals and a general policy for the future of the whole movement.

The Congress, which will meet in the Lecture Theatre of the University of London, will include three sessions, to be held on Friday afternoon, June 22, and Saturday morning and afternoon, June 23. The Marquis of Salisbury, the Duke of Devonshire, and Lord Herschell, will preside at the three sessions respectively.

The subjects for discussion will be:—

(1) The means of preserving and further developing the educational character of University Extension work, and the relation of the more popular to the more strictly educational side of the movement.

(2) The essentials of efficient central and local organisation, and the relation, educational and financial, of the University Extension Movement to the State and to local authorities.

(3) The educational possibilities of University Extension work and methods in relation to regular University studies and University degrees.

The subjects will be considered beforehand by a committee or committees of experts, who will present reports and formulate the resolutions to be submitted for discussion to the Congress. The Right Hon. the Lord Mayor has intimated his intention of inviting the members of the Congress to a reception at the Mansion House on the evening of Friday, June 22.

At the last meeting of the Council of the Durham College of Science, Mr. Henry Palin Gurney, formerly Fellow of Clare College, and Deputy-Professor of Mineralogy in the University of Cambridge, was appointed Principal.

SCIENTIFIC SERIALS.

"*American Meteorological Journal*, April.—"Storms of the Gulf of Mexico and their prediction," by W. D. Stearns. Many of the storms which enter the United States from the Gulf of Mexico are very destructive, and give scarcely any indication of their approach by means of the barometer. The author has made a special study of local conditions and cloud movements which preceded a number of storms in 1892 and 1893, and thinks that by those means their presence may be detected in every case some hours in advance of their arrival. Notes are given of the phenomena preceding several storms.—A new chart of equal annual ranges of temperature, by J. L. S. Connolly. The chart was constructed on the basis of Dr. Buchan's "Challenger" isothermal charts. It shows that the torrid zone is, on the whole, a region of moderate annual range of temperature, while the north temperate zone has extreme variations compared with the south temperate. The effects of solar and terrestrial radiation are well shown; in northern Asia there is a range of 120°, and of 80° in the northern part of North America.

Bulletins de la Société d'Anthropologie de Paris, tome iv. No. 12.—This number contains a valuable memoir by M. L. Manouvrier on the normal and abnormal variations of the nasal bones in the human species. Whatever may be the original cause of variation, it is interesting to observe that that cause is sufficient to produce in one and the same race individual varieties suggesting all kinds of ethnic types. In one case, figured by

M. Manouvrier, the nasal bones are entirely suppressed, their place being supplied by the frontal bone.—M. G. de Mortillet proposes an important reform in chronology; he points out the inconvenience of using several different eras, such as the Foundation of Rome, the Birth of Christ, the Flight of Mohammed, or the Proclamation of the Republic, and suggests that 10,000 years before the Christian era should be adopted as a general starting point; this would not only include all Egyptian chronology, as known at the present day, but would also leave 5000 years at the disposal of future discoverers.—At the Broca conference, Dr. Capitan delivered a lecture on the rôle of microbes in society.—M. J. Deniker has contributed a paper on the natives of Lifou, one of the Loyalty Islands. The average stature of these islanders is somewhat below middle height (1642 mm.), although in the case of four individuals out of the ten examined by Dr. Francois, whose observations form the basis of this communication, the stature was from 1670 to 1690 mm.; the head is dolichocephalic (cephalic index = 72.4), and the nose is platyrrhine (nasal index = 97.8); five out of the ten subjects were hyperplatyrrhine (index 101 to 117). The colour of the skin, in the majority of those examined, resembled chocolate with a reddish tinge (23-29 Broca), while one of them had a light brown skin, and two others were black. The colour of the iris varied from brown to dark brown, the darker tinge predominating.—In a paper on family property in Anam, M. Paul Denjoy describes the organisation of the family, the prescriptions of the law with regard to succession and wills, and the extensive system of registration employed. He gives a good general idea of Anam's legislation, and of the principles that underlie it. The number includes several short communications of much interest.

Wiedemann's Annalen der Physik und Chemie, No. 4.—On the formation of floating metallic films by electrolysis, by F. Mylius and O. Fromm. A zinc plate is laid on the bottom of a glass jar, and is covered with a layer of 50 per cent. solution of zinc sulphate. A platinum wire 0.2 mm. thick touches the surface of the solution vertically. On passing a current from a 3-volt battery through the solution, a bright film of metallic zinc is formed round the platinum cathode, which gradually expands, and exhibits an approximately circular form, but subsequently becomes irregular. The phenomenon does not take place unless the surface of the solution is tainted with some substance insoluble in water, such as oil of turpentine. This may form a separate thick layer, and the film is produced at the separating surface. It may also be produced at the lower surface of the zinc sulphate solution by first pouring a layer of chloroform on to the zinc anode. Other metals, such as iron, cobalt, cadmium, silver, show analogous phenomena.—On the elasticity and tenacity of some new glasses as dependent upon their chemical composition, by A. Winkelmann and O. Schott. The coefficients of elasticity, and those of resistance to tension and pressure, were determined experimentally for eighteen kinds of glass. The first lies between 4699 and 7592 kg. per sq. mm. The second lies between 3.5 and 8.5 kg. per sq. mm., and the third between 60.6 and 120.8. These results may be represented by formula depending upon chemical composition, the calculated values varying by 3 per cent. from the observed ones in the case of elasticity, and about 8 per cent. in the case of tenacity.—On the coefficient of thermal resistance of different glasses as dependent upon chemical composition, by the same authors. The thermal resistivity is the property enabling glasses to withstand sudden cooling without breaking. It depends upon the elasticity, the tenacity, the thermal expansion and conductivity, the specific heat, and the specific gravity of the glass in question. In most cases the resistivity can be calculated with fair approximation if these properties are known.

Internationales Archiv für Ethnographie, vol. vii. parts 1 and 2.—The new volume of this useful journal is continued along the same lines as the previous volumes; the publisher only is changed. Heer Trap still prints the letter-press, and turns out the plates in his usual skilful manner. Prof. G. Schlegel gives the first published illustration and full description of "A Canton Flower-boat," or, as it should be called, "Gaudy Boat." These are really floating café-chantants, in which the greatest decorum prevails; they are hired for evening festivals and suppers, by wealthy officials and others.—Leo V. Frobenius has an interesting article, illustrated by three plates, on "Ceramics and their origin from Wood-carving in the Southern Congo Basin." He deals with the pottery trade, the form of clay vessels, wooden

vessels, ornamentation, images in wood and clay, &c. He comes to the conclusion that the leather-work is the oldest industry of the Negro, and was followed by wood and plaited work, from which finally arose ceramics. The author agrees with Schurtz that a Wooden age replaced the Stone age in Africa, and was followed by the Iron age; the latter took place quickly on account of the superiority of iron weapons and utensils over wooden ones, but pottery slowly superseded wooden vessels and gourds, and has undergone only a slight development. The second part is mainly taken up with an elaborate article by J. Walter Fewkes, on the "Dolls of the Tusayan Indians." These are carefully described, and their symbolism is noted; coloured illustrations are given of forty-three of them. He points out that the characteristic details are always found on the head, and adds, "this fact is one which gives a great importance to the study of helmets, masks, and all cephalic decorations which are used in ceremonial dances."—Prof. P. J. Veth, on "Signature-lore" (De Leer der Signatuur); signature being "the resemblance of a vegetable or a mineral to any part of a man's body."—The first part of an essay of a branch of sympathetic magic deals with the subject in general, and a detailed account of the Mandrake (*Mandragora*).—K. Parkinson sends a note, which is illustrated, on the boring of shells in the manufacture of arm-rings, &c. The shell is partially embedded in and lashed to a board, and the hole is drilled by means of a bamboo cylinder, to which a flat stone is fastened as a fly-wheel, sand and water is used as emery; when half cut through, the piece of shell is reversed.

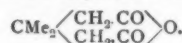
Annalen des K.K. naturhistorischen Hofmuseums, Bd. viii. Nos. 2, 3-4. (Wien: A. Hölder, 1893.)—Dr. O. Finsch, in the last number of this publication, completes his "Ethnologische Erfahrungen und Belegstücke aus der Südsee." The sub-title describes this as a descriptive catalogue of a collection in the Vienna Museum. It rarely happens that an ethnological collection in a museum is so fully described as this has been, but in this case the author describes the specimens he has himself collected. The catalogue commenced in the third volume (1888) of the *Annalen*, and now concludes, having run to 675 pages, and having been illustrated by twenty-five plates and numerous illustrations in the text. But it is more than a mere illustrated catalogue, for the author has incorporated original ethnological investigations as well as given authentic accounts of the various objects enumerated. The whole series of papers forms an invaluable addition to the libraries of museums and of those interested in such subjects. The current numbers contain Dr. Finsch's account of the Marshall Archipelago and of the Caroline Islands, including Kuschai, Ponapé, Kuk, and Mortlock; to this are appended addenda to and corrections of statements in the earlier papers, and several indices.—Eight new species of Hymenoptera belonging to the genus *Gorytes*, Latr., are described by A. Handlirsch (p. 276).—Prof. F. Toulou has (p. 283) a preliminary communication on the fauna of the Miocene beds of Kralitz in Mähren; the Foraminifera are most fully noted.—Dr. A. Zahlbruckner gives a description (p. 438) and plate of a new species of lichen (*Pannaria austriaca*).—Dr. F. Berwerth follows, also with a coloured plate, "On *Alnöt* from Alnöt."—F. F. Kohl (p. 455) has a monograph, with three plates, on *Ampulex*, Jur. (s.l.) and allied genera of Hymenoptera. Numerous new species are described.—F. Siebenrock has an illustrated and carefully worked-out paper on the skeleton of *Uroplatus fimbriatus*, Schneid., one of the Geckos.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, March 15.—Dr. Armstrong, President, in the chair.—The following papers were read:—Formaldoxime, by W. R. Dunstan and A. L. Bossi. Formaldoxime has previously only been known as a gas or in solution; the authors have obtained it as a colourless liquid boiling at 84°-85°.—Derivatives of camphene containing halogens, by J. E. Marsh and J. A. Gardner. Chlorocamphene, $C_{10}H_{15}Cl$, is prepared by distilling camphene dichloride, and bromocamphene is obtained by the action of bromine and phosphorus chloride on camphor.—A sulphate of oxamide, by J. E. Marsh. A hot solution of oxamide in strong sulphuric acid deposits crystals of oxamide disulphate ($CONH_2 \cdot H_2SO_4$), on cooling.—Fluoplumbates and free fluorine, by B. Brauner. The author has prepared a fluo-

plumbate of the composition $3KF, HF, PbF_4$; on treatment with sulphuric acid it yields lead tetrafluoride.—The action of nitrosyl chloride on unsaturated compounds, by W. A. Tilden and M. O. Forster.—Note on the action of nitrosyl chloride on amido-derivatives of benzenoid hydrocarbons, by W. A. Tilden and J. H. Millar. Nitrosyl chloride acts on aromatic amido-compounds yielding a diazo-derivative, a nitroso-compound, or a chloro-derivative.—Action of aluminium chloride on heptyl chloride; a correction, by F. S. Kipping.—Oximidosulphonates or sulphazotates, by E. Divers and T. Haga. A number of salts of oximidosulphonic acid have been prepared and their reactions studied.—Derivatives of tetramethylene, by W. H. Perkin, jun. Tetramethylethylamine is obtained as a colourless oil, by the action of potash and bromine on the amide of tetramethylenecarboxylic acid.— β -2-Dimethylglutaric acid, $COOH \cdot CH_2 \cdot CMe_2 \cdot CH_2 \cdot COOH$, by W. Goodwin and W. H. Perkin, jun. This acid, which is probably closely allied to camphoric acid, yields an anhydride of the constitution



—The products of the action of fused potash on camphoric acid, by A. W. Crossley and W. H. Perkin, jun.—Conversion of ortho-into para-, and of para-into ortho-quinone derivatives. II. Dinaphthylidiquinone, by S. C. Hooker and J. G. Walsh, jun.

March 22.—Anniversary meeting.—Dr. Armstrong, President, in the chair.—After the reading of the President's address and the Treasurer's report, a ballot was taken for the election of officers and Council for the ensuing session. The ordinary members of Council are the following:—C. F. Cross, H. Dixon, B. Dyer, R. J. Friswell, A. G. Green, F. S. Kipping, W. H. Perkin, jun., W. A. Shenstone, T. Stevenson, J. A. Voelcker, W. P. Wynne, and S. Young.

Zoological Society, April 17.—W. T. Blanford, F.R.S., Vice-President, in the chair.—Mr. Sclater made some remarks on the possibility of breeding the African Mud-fish (*Protopterus*) in the Society's Gardens, and called attention to a recently published paragraph in "Le Mouvement Géographique" in which some account was given of the phenomena of reproduction of this Mud-fish, as observed by the French missionaries on Lake Tanganyika.—Prof. Karl von Bardeleben, of Jena, read a paper on the bones and muscles of the mammalian hand and foot, in which he explained his views on the rudiments of the sixth and seventh digits or rays. These rudiments, as he showed, are situated both on the inner and the outer borders of the hand and foot; they are present in nearly all the orders of mammals, especially in the lower forms, and are always provided with special muscles.—Dr. G. Herbert Fowler pointed out the characters of a new species of Sea-Pen of the family *Veretillidae* from a specimen belonging to the Madras Museum, and proposed to call it *Cavernularia malabarica*. Dr. Fowler likewise exhibited and made remarks on an example of *Lidaria phalloides* belonging to the same Museum.—Mr. F. E. Beddard, F.R.S., described two new genera comprising three new species of Earthworms from Western Tropical Africa.—A communication was read from Mr. Oldfield Thomas containing an account of a new Antelope from Somaliland, which he proposed to call *Neotragus rupicola*. Capt. H. G. C. Swayne, R.E., and his brother, Capt. E. Swayne, had discovered this Antelope during their recent explorations in that country, but had not been able to bring back specimens. Two skins and a frontlet, lately received by Capt. H. G. C. Swayne from his native hunters, had enabled Mr. Thomas to establish the species.

Geological Society, April 11.—Dr. Henry Woodward, F.R.S., President, in the chair.—Mesozoic rocks and crystalline schists in the Lepontine Alps, by Prof. T. G. Bonney, F.R.S. The author described the results of an examination of the infold of Jurassic rock in the Urserenthal, undertaken in the hope of finding some definite evidence as to the relations of the marble, exposed near the old church at Altkirche, and the adjacent Jurassic rocks.—The easternmost of the sections described occurs high up on the slopes north of the Oberalp road. Read off from the northern side it exhibits (1) gneiss, (2) phyllites with bands of subcrystalline limestone, &c.—Jurassic, (3) a little rauchwacke, (4) "sericitic" gneiss. The next section (about 250 feet above the St. Gothard road at Altkirche) gives (1) gneiss, (2) covered ground, (3) slabby marble, (4) phyllite, (5) thicker mass of slabby

marble, (6) phyllite, &c., (7) "sericitic" gneiss. The third section runs thus, using numbers to correspond with the last:—(1) gneiss, (4) phyllite, (5) slabby marble, (6) phyllite, &c., (7) "sericitic" gneiss. It must be remembered that on the slopes of the Oberalp farther south, between the "sericitic" gneiss and the "Hospenthal Schists," another dark phyllite is found, generally considered by the Swiss geologists to be carboniferous. The marble in the third section is in places distinctly banded with white mica, and passes on the northern side into fairly normal mica schist and quartzose schist. The fourth section, about a mile away, on the left bank of the Reuss valley, gives a practically continuous section in phyllite and dark limestone, without any marble. In the fifth section, rather more than a mile farther, if any marble is present, it is very thin and shattered. At Realp, about 3½ miles farther, the next good section is obtained. Here the rocks go in the following order (from the northern side):—(1) Gneiss; (2) phyllite and limestone; (3) sub-crystalline limestone, looking very crushed; (4) the marble; (5) phyllite, etc.; (6) Hospenthal schists. The last group of sections occurs near the Furka Pass. In the first, crossed by the high road, there is no marble, but a little rauchwacke on the southern side. The next one, on the slopes below the pass, seems to show two masses of the marble parted by a subcrystalline limestone like that at Realp, with phyllite above and below. Of the two masses of marble the southern one can be traced right across the pass, but the extent of the other is not so clear. Examination of the marble mentioned above shows in all cases that it has been considerably modified by pressure since it became a crystalline rock. The author discussed the evidence of these sections, and maintained that the hypothesis that the marble is an older rock intercalated by thrust-faulting among Jurassic strata leads to fewer difficulties than to consider it as belonging to the same system. In the latter part of the paper the results of a re-examination of the ravine-section in the Val Canaria, and of some studies of the south side of the Val Bedretto are described, which, as the author maintains, confirm the view already expressed by him, viz. that the schists with black garnets, mica, kyanite, dolomite, and calcite (the last sometimes becoming marbles) are not altered Jurassic rocks but are much older.—Notes on some trachytes, metamorphosed tuffs, and other rocks of igneous origin, on the Western Flank of Dartmoor, by Lieut.-General C. A. McMahon. In this paper the author noticed the occurrence of felsite and trachyte at Sourton Tor; of rhyolite and of aluminous serpentine at Was Tor; and of a dolerite at Brent Tor in the exact situation indicated by Mr. Rutley as the probable position of the throat of the Brent Tor volcano. The author described extensive beds of tuffs at Sourton Tor and Melton, the matrix of which has been converted, by contact-metamorphism, into what closely resembles the base of a rhyolite, and which, in extreme cases, exhibits fluxion-structure, or a structure closely resembling it. The fragments included in this base were so numerous that six or seven different species of lavas may be seen in a single slide; this fact, and a consideration of the extensive area over which these beds extend, led the author to believe that these beds were metamorphosed tuffs and not tuffaceous lavas. He then described some beds on the flank of Cock's Tor, which give evidence on their weathered surface of an original laminated structure by exhibiting a corded appearance like corduroy cloth. These beds are composed of colourless augite, set in a base which in ordinary light looks like a structureless glass, but which between crossed nicols is seen to be an obscurely crystalline felspar. The author compared these rocks with that portion of the Lizard hornblende-schists for which a tuffaceous origin was proposed by De la Beche and other writers, including Prof. Bonney and himself. He showed that the Lizard schists and the Cock's Tor rocks agree in specific gravity and in some other characteristics; and he concluded that at Cock's Tor the first stage in the conversion by contact-action of beds of fine volcanic ash into hornblende-schist had been completed, and the final stage, due to aqueous agencies, had just begun.

Linnean Society, April 19.—Prof. Stewart, President, in the chair.—Sir Joseph Hooker exhibited a portrait of Jeremiah Bentham, father of Jeremy and Sir Samuel Bentham, born 1710, died 1792.—Dr. Prior exhibited specimens of *Pinus Pinaster* with undeveloped catkins, like berries, and other specimens of conifers in flower.—Mr. J. R. Jackson exhibited an Afghan knife, the sheath of which was bound with bark of *Caragana decorticans*, selected on account of its bronze-like

appearance, and gave some account of the various native uses to which this bark is put.—On behalf of Mr. George Mayor and Mr. F. R. Maw, some photographs of abnormally situated nests of the robin were exhibited, one of which had been built upon a book-shelf in one of the studies at Tunbridge School, and another in an old tin teapot which had been flung aside as useless, and had lodged in a poplar.—Mr. B. Shillito exhibited and made remarks upon an abnormal hyacinth.—An account of British Trap-door spiders was then given by Mr. F. Enock, and by the aid of the oxy-hydrogen lantern and some excellent slides, their appearance and mode of life was graphically delineated and described.—In view of the approaching anniversary meeting, the election of auditors was next proceeded with, when Mr. Batters and Prof. Howes were nominated on behalf of the Council, and Mr. Michael and Mr. J. Groves on behalf of the Fellows.—In the absence of the author, Mr. George Murray gave an account of Graf zu Solms-Laubach's monograph of the *Acetabulariæ*, and the principal points were illustrated with lantern slides. The limits of the group were defined as excluding *Dasycladea*, and containing the living genera *Acetabularia*, *Polyphysa*, *Halicoryne*, and *Pleophysa*, of which the author maintained only the first and third named. The extinct forms, principally *Acicularia*, were dealt with very exhaustively, and their relation to the living ones indicated. The paper consisted of a morphological account of all the forms, as well as a detailed systematic review of them, and the author's views of the relationship of the grasses to the forms of *Dasycladea*, *Cymopolia*, *Neomeris*, *Bornetella*, &c., possessed much novelty and interest.

PARIS.

Academy of Sciences, April 23.—M. Lœwy in the chair.—On an example of divergent successive approximations, by M. Émile Picard.—Some preliminary remarks on the mechanism for excretion of albuminoids, and the formation of urea in the economy, by M. Armand Gautier.—Observations on the remarks of M. Armand Gautier, by M. A. Chauveau. M. Berthelot followed with a further observation, affirming M. Gautier's view of the production of carbonic anhydride without direct oxidation by means of free oxygen.—On the fossils collected at Montsaunès by M. Harlé, by M. Albert Gaudry. The author brings forward a number of these remains as proving the warm-temperate climate obtaining at Montsaunès at the period to which the remains of a monkey found there belong.—A note by M. Potain explaining the scope and production of a work presented.—"Clinique médicale de la Charité."—On rolling movements, by M. Hadamard.—On the agglomeration of explosive substances, by M. P. Vieille. The author continues his experiments showing the effect on the speed and character of combustion of the state of aggregation of a powder produced in its manufacture.—On the variation of rotatory power under the influence of temperature, by M. A. Le Bel. A decrease in amount of rotation is recorded, for several substances, with lowering of temperature. This is not due to polymerisation, but may be accounted for by a loss of mobility in the molecule—"La molécule subit alors comme une sorte de congélation interne."—On the electrical capacity of mercury and the capacities for polarisation in general, by M. E. Bouty.—On the partition of the discharge of a condenser between two conductors, one having an interruption, by M. R. Swynedauw. If the sparking distance in a part of the unbranched circuit be I_1 and in the interrupted branch I_2 , then with I_1 constant the quantity of electricity passing through the uninterrupted branch increases continuously with the distance I_2 , becoming greater than the total charge when I_2 exceeds a certain value. The value of I_2 giving this quantity equal to the total charge increases with I_1 .—On the sodium derivative of ethyl acetate, by M. de Forcrand. The preparation of the pure derivative is described, and, from experiments on the partially dehydrated salt, the heat of hydration of the anhydrous substance is given as 4.19 Cal., and the heat of solution in 4 litres of water at 12° is found to be 4.39 Cal.—On the detection of "abastol" in wines, by M. L. Briand.—The parasitic Diptera of the Acridians: Bombylides. Larval hypnodic and metamorphosis with period of activity and period of repose, by M. Kiunkel d'Herculais.—On the circulatory apparatus of *Dreissensia polymorpha*, by M. Tourenq.—Researches on the structure of lichens, by M. P. A. Dangeard.—On ligneous tumours produced by an ustilago among the eucalyptus, by M. Paul Vuillemin.—Observations apropos of the note by M. Calmette, relative to the poison of

serpents, by MM. C. Phisalix and G. Bertrand. A claim for priority.—Experimental researches on the place of formation of urea in the animal organism. Preponderating rôle of the liver in its formation, by M. Kaufmann. The formation of urea is not entirely localised in the liver; all the tissues produce a certain quantity, though they are not so active as this organ. The production of urea seems to be allied to the phenomena of nutrition in the various tissues, and the phenomena of elaboration of nutritive materials in the blood by the hepatic gland.—The production of "glycosurie" in animals by psychical means, by M. Paul Gibier. The case of a dog is quoted in which isolation from its usual companions is followed after about three days by the appearance of sugar in the urine. The phenomenon persists during deprivation of liberty and companionship, but immediately ceases on restoration of the animal to its usual conditions.—On a new and special sense, by M. Danion.—A contribution to the study of the pest of fresh waters, by M. E. Bataillon. The diplobacillus described attacks fish at all stages of life. It also attacks crayfish.

AMSTERDAM.

Royal Academy of Sciences, January 27 (supplement).—Prof. van de Sande Bakhuyzen in the chair.—Prof. Kamerlingh Onnes gave the results of the measurements of Mr. C. H. Wind on the Kerr phenomenon in polar reflexion on nickel. The result is that the difference between the observed phase and that given by the theory of Prof. H. A. Lorentz has a constant value, as pointed out by Sisingh and introduced in Goldhammer's theory. For the phase of Sisingh the value of 37° was found. According to Drude's theory, it ought to be 60° . The difference is here much more marked than in the case of cobalt, from which Zeeman concluded in favour of Goldhammer's theory, and it leaves no doubt as to the validity of this conclusion. The experiments were described of Mr. M. de Haas, who has repeated the measurements of the coefficient of viscosity of methyl-chloride at temperatures approaching the critical temperature, previously made in his laboratory by Dr. L. M. T. Stoel. The results of Stoel were confirmed, and the method was modified so as to give the viscosity in absolute measure. The viscosities of Cl Me and CO_2 in the neighbourhood of the critical point were also confirmed. A sufficient accordance was found with the theorem, that in Van der Waals' corresponding states of two fluids the viscosity is in a definite ratio that can be calculated from the critical data.

March 31.—Prof. van de Sande Bakhuyzen in the chair.—Prof. H. Behrens gave an account of experiments on alloys of iron with chromium and tungsten, performed by Mr. van Lingen and himself in the laboratory of the Polytechnic School at Delft. In a ferrochrome with 13.3 Cr, 5.5 C, a ground mass was found, showing a hardness a little superior to iron, and yielding Fe and Cr to hydrochloric acid. By treatment with aqua regia the metal was disintegrated, and when observed under the microscope showed well-defined monoclinic prisms, which had a hardness between that of quartz and topaz (7.5), and resisted the corrosive action of aqua regia for a fortnight. After washing with a heavy solution (3 g. 2 S), the composition of this compound was found to be 75.8 Fe, 16.8 Cr, 6.7 C. Chromium steel, with 7.5 Cr, 2.5 C, was subjected to the same treatment, yielding grains and small prisms of the same form and hardness. Analytical examination gave the following result:—73.5 Fe, 20.0 Cr, 6.7 C. From this the empiric formula $\text{Cr}_2\text{C}_2\text{Fe}_7$ can be deduced. Similar crystals were isolated from a ferrochrome with 50 per cent. Cr, much chromium being dissolved in strong hydrochloric acid. From ferrotungsten, containing much Mn and S, beautiful rhombic octahedra were obtained, containing 69.5 Fe, 28.9 W, 1.6 S; from another sample, poor in Mn and S, similar crystals, composed of 65.2 Fe, 28.6 W. Both have a hardness superior to feldspar. Evidently the great hardness of these alloys must be ascribed to well-defined compounds of three elements, not, as heretofore to allotropic modifications of iron. This investigation will be extended to ferromanganese and to bronzes, containing Al and S.—Prof. Kamerlingh Onnes described the experiments on electrolytic polarisation, made by Dr. T. H. Meerburg in Prof. V. A. Julius' laboratory at Utrecht. The polarisation during the first seconds was measured with a capillary electrometer by a zero method on the Fuchs principle, the apparatus giving the means of registering the time. The maximum of Cathodic polarisation was reached one second after the beginning of the polarising current. A formula for the increase of polarisation

with time differing from that of Witkowski was deduced from theory. A careful repetition of Root's experiment on the transmission of electrolytic hydrogen by platinum foil of $\frac{1}{16}$ mm. gave a negative result. Insufficient isolation or some other error may have been the cause of what Root had observed.

BOOKS, PAMPHLETS, and SERIALS RECEIVED

BOOKS.—A Vindication of Phrenology: W. M. Williams (Chatto and Windus).—Exkursionsbuch zum Studium der Vogelstimmen: Dr. A. Voigt (Berlin, Oppenheim).—Electric Light Installations: Sir D. Salomons, Vol. 2, Apparatus, 7th edition (Whittaker).—A Manual of the Geology of India: R. D. Oldham, 2nd edition (K. Paul).—A Manual of Ethics: J. S. Mackenzie, 2nd edition (Clive).—Primer of Navigation: A. T. Flagg (Macmillan).—Eight Hours for Work: J. Rae (Macmillan).

PAMPHLETS.—Die Abstammungslehre und die Errichtung eines Institutes für Transformismus: Dr. R. Behla (Kiel, Lipsius und Tischer).—The Principles of Elliptic and Hyperbolic Analysis: Dr. A. Macfarlane (Boston, Cushing).—Les Femmes dans la Science: A. Rebière (Paris, Nony).

SERIALS.—Zeitschrift für Physikalische Chemie, xiii. Band, 4 Hft (Leipzig, Engelmann).—Memoirs of the Geological Survey of India, Paleontologia Indica, series 9, Vol. 2, Part 1; The Echinoidea of Cutch: J. W. Gregory (K. Paul).—Familiar Wild Birds: W. Swainsland, Part 1 (Cassel).—Zeitschrift für Wissenschaftliche Zoologie, lviii. Band, 3 Hft (Leipzig, Engelmann).—Mittheilungen der Prähistorischen Commission der Kais. Akad. der Wissenschaften, 1. Band, No. 2 (Wien, Tempaky).—Natural Science, May (Macmillan).—American Journal of Mathematics, Vol. xvi. No. 2 (K. Paul).—Quarterly Journal of Microscopical Science Special Complimentary No. dedicated to E. Ray Lankester (Churchill).—Agricultural Gazette of New South Wales, March (Sydney).—Records of the Geological Survey of India, Vol. xxvii. Part 1 (Calcutta).—Geographical Journal, May (Stanford).—Contemporary Review, May (Isbister).—New Review, May (Heinemann).—Scribner's Magazine, May (Low).—Sunday Magazine, May (Isbister).—Humanitarian, May (Sonnenschein).—Longman's Magazine, May (Longmans).—Good Words, May (Isbister).—Century Magazine, May (Unwin).—Chambers's Journal, May (Chambers).—English Illustrated Magazine, May (Strand).—Geological Magazine, May (K. Paul).—Travaux de la Société des Naturalistes à l'Université Impériale de Kharkov, tome xxvii. 1892-93.—A Manual of Orchidaceous Plants, Part x. (Veitch).—The Natural History of Plants: Prof. A. K. von Marilaun, translated by Prof. F. W. Oliver, Part 1 (Blackie).

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